Saving Mothers and Children in a Post-Conflict Setting: Improving the Quality of Maternal & Child Health Services in Afghanistan

By

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Abstract

Since the Taliban government was toppled in 2001, Afghanistan has been rebuilding its devastated health system through implementation of the Basic Package of Health Services (BPHS). The BPHS was initiated in 2003 and subsequently complemented by integration with the Essential Package of Hospital Services (EPHS) in 2005. Together, the BPHS and EPHS form the core of Afghanistan's main health care delivery system. Since the initiation of BPHS, one of the key strategies has been improving the quality of maternal and child health services in Afghanistan. This dissertation focuses on the quality of maternal and child health services and assesses the effects of improving quality of services provided at frontline facilities on selected key outcomes. Study Aim 1 (SA (1)) is to quantify the association between the structural quality of maternal health services and utilization of institutional delivery services. Study Aim 2 (SA (2)) is to estimate the association between health workers' adherence to clinical guidelines for Integrated Management of Childhood Illnesses (IMCI) and their likelihood of providing accurate diagnosis for pneumonia and diarrhea in children under 5 years of age.

The analyses in the dissertation draw on 8 rounds of nation-wide data collected between 2004 and 2013 as part of National Health Service Performance Assessments in Afghanistan. Each year's sample included a stratified random sample of different types of health facilities and systematic random samples of patients and health workers in the chosen facilities. The longitudinal and multilevel data analysis methods employed in SA (1) and (2) respectively, take advantage of the temporality of datasets and control for clustering in accordance with the sampling methods.

The analysis for SA (1) provides strong evidence that structural quality improvement of maternal health services was positively associated with increases in facility births. Facilities supported by Non-Governmental Organizations (NGO) had higher institutional delivery rates than did facilities without any support. Increased rates of institutional deliveries were also associated with higher level facilities, a higher number of staff, and higher total volume of non-delivery services at the facilities. The analysis for SA (2) found a significant positive association between process quality of pediatric care, as

measured by health workers' adherence to IMCI clinical guidelines, and their likelihood of providing accurate diagnosis for pneumonia and diarrhea for children under 5 years of age. The analysis also indicated that context mattered, i.e. there were contextual factors at the province level at play either positively or negatively affecting accurate diagnosis, which lies at the heart of successful clinical management of the two diseases. The findings also highlighted that there is considerable room to strengthen IMCI skills and performance of health workers to reduce under-diagnosis of children with serious illnesses.

The dissertation adds evidence, from post-conflict Afghanistan, that improving quality of maternal and child health services can contribute to increased service utilization by mothers, as well as to more accurate diagnoses of the top two diseases that kill children. Since quality improvement, increased utilization rates and more accurate diagnoses are part of key strategies for tackling maternal and child morbidity and mortality, the findings should stimulate continued investment in, and focus on, improving the quality of health services in Afghanistan through the BPHS and EPHS. The findings also serve as a reminder that health systems strengthening efforts should be contextualized at appropriate levels, i.e. individual, facility, provincial or national, through an ongoing exchange of insight and evidence among multiple stakeholders at and between different levels.

Acknowledgement

I am who I am, what I am and where I am because of my parents. I am eternally indebted not only to their unconditional love and countless sacrifices but also to their lead by example on how to be a compassionate human being for others. Being born to and raised by an incredible duo of kind caring health professionals who never tire to give back to the community in their best capacity is the best thing that could happen to me. As a matter of fact, I personally consider it the greatest sociodemographic lottery any one person could ever win. Mom and Dad, you are my heroes and will forever be.

The DrPH from a university as prestigious as the Johns Hopkins would still be a far-fetched dream if it was not for the ceaseless support and love from my wife who endured numerous challenges and difficulties along this journey. Thank you for bearing with my shortcomings and continuing to love and care for me during what I believe are our most difficult years (unless of course I decide to do a post-doc). You are my refuge. Nge, thank you for holding my hand.

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As I am typing these words at a comfortable desk on an air-conditioned campus feeling a certain degree of sense of accomplishment, I am not forgetting that much is yet to be done. It keeps dawning on me that the end of the DrPH program is only the means to a far greater end. The essence of a DrPH does not lie in acquiring it but in the application of itself. I am not forgetting about the world's problems and am reflecting on how the people I mentioned above helped me strengthen my ability to contribute to solving such challenges. In fact, writing the acknowledgement session of my dissertation is the most opportune time to re-affirm my vows to do my part to make the world a better place. I will fight on. *Metta*.

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List of Acronyms

AMA – Afghan Midwives Association

ARI – Acute Respiratory Tract Infection

BHC – Basic Health Center

BPHS – Basic Package of Health Services

BSC – Balanced Score Card

CHC – Comprehensive Health Center

CHW – Community Health Worker

EPHS – Essential Package of Hospital Services

HP – Health Post

IIHMR – Indian Institute of Health Management Research

IMCI – Integrated Management of Childhood Illnesses

JHSPH – Johns Hopkins Bloomberg School of Public Health

MCH – Maternal and Child Health

MNCH – Maternal, Neonatal and Child Health

MOPH – Ministry of Public Health

NHSPA – National Health Service Performance Assessment

PH – Provincial Hospitals

SA – Study Aim

SH – National Specialty Hospital

SC – Sub-center/ sub health center

TB - Tuberculosis

1. Chapter (1): Introduction

Brief Study Rationale

Shortly after the fall of the Taliban government in 2001, Afghanistan, donors and international partners started implementing a nation-wide health system strengthening strategy, named the Basic Package of Health Services (BPHS). The BPHS was initiated in 2003, as a collective effort to rebuild the health system that had been weakened by years of conflicts, and inability to prioritize and invest in health. In 2005, the BPHS was integrated with the Essential Package of Hospital Services (EPHS). Together, the BPHS and EPHS formed the core of Afghanistan's health care delivery system. Since the conception of BPHS, improving the quality of maternal and child health has been one of the focus areas of Afghanistan's strategies.

This dissertation attempts to determine if improving the quality of maternal and child health services, provided at frontline facilities of Afghanistan, is associated with selected key outcomes on health services. Study Aim (1) is to study, and quantify, the association between structural quality of maternal health services and the utilization of institutional delivery services at the facility level. Study Aim (2) is to quantitatively assess the association between health workers' adherence to the clinical guidelines entitled "Integrated Management of Childhood Illnesses" (IMCI), and their likelihood of providing accurate diagnosis, and their likelihood of avoiding under-diagnosis, for pneumonia and diarrhea in children under five years of age.

A Persisting Challenge through the 21st Century

Although the world has seen a 44 percent drop in worldwide mortality between 1990 and 2015, approximately 830 women still die each day from preventable causes related to pregnancy and child birth, according to the latest WHO statistics on maternal health. In 2015, an approximate 303,000 women die during pregnancy, intrapartum and post-natal period. In the same year, 5.9 million deaths of children under the age of 5 were estimated; this is equivalent to approximately 11 children per minute [1]. Despite significant achievements in maternal and child health, these figures are snapshots that reminds the mission that lies ahead of us and that is yet to be fulfilled in the 21st century.

Improving maternal and child health, and removing its associated inequity, is a top priority in the global health agenda, and among concerned professionals from related fields, such as development, politics, economics, and sociology. High rates of maternal and child mortalities are concentrated in low-resource countries and in poor populations. The gap between the countries with the highest rate of maternal deaths and those with the lowest has doubled between the 1990s and 2010s [2].

Almost all maternal deaths occurred in developing settings. In fact, 99 percent of maternal deaths occur in developing countries and most could have been prevented. One third of maternal deaths is accounted by only two countries: Nigeria (40,000 deaths) and India (50,000 deaths) [3]. Furthermore, the lifetime risk of dying during pregnancy and childbirth is also astoundingly different among regions. Women in Europe have a lifetime risk of 1 in 3,300, while women in Africa face a risk of 1 in 40. To compare and contrast the extremes at the country level, the lowest lifetime risk is in Sweden, approximately one in 30,000, while the highest lifetime risk is in Afghanistan and Sierra Leone, with a probability of one in six [4]. The inequity gap between the burden of maternal mortality in developed and developing countries has long been cited as the “largest discrepancy of all public-health statistics” [5].

The prevalence of inequity is also seen in child health. Children in sub-Saharan Africa have a 15 times higher chance of death before the age of 5 than do children in developed regions. Only five countries accounts for half of these worldwide deaths [6]. It is also known that children have greater risk of dying if they are born in rural areas, to households with poor socioeconomic status and to a mother with no or little education[7].

Despite these known inequities, universal access to Maternal and Child Health services is yet to be achieved in many countries.

Strategic Role of MCH Services

The health of mothers and children is a focus area that was given priority well before the 1990s. It has been built progressively on a century of programs, activities, learning and experience. Towards the end of the 2000 millennium, the fate of MCH was reinvented with the development of the Millennium Development Goals. The global uptake of MDGs, and the need to monitor associated progress, have ensured that maternal and child health services continue to receive attention.

The perspective on MCH has also changed over the years. Mothers and children are now seen not only as targets for health programs, they are seen as global citizens who are equally entitled to quality care and services. Consequently, the outlook on MCH has shifted from a technical standpoint, to a moral and political imperative. Mother and child care is no longer just a domain domestic to mothers and midwives; it becomes a public health priority [8, 9].

MCH services are often at the core of health systems strengthening strategies. Developing countries usually have poor MCH indicators, in part because of weak health systems. Country and health systems experts see that improving the health of mothers and children is an opportunity to strengthen health systems and vice versa.

The World Health Organization (WHO) stated that the development of meaningful MCH programs should be underlined by the concept of 'continuum of care'. In this instance, the expression of continuum means two things: (1) care has to be provided as a continuum throughout the life cycle, including adolescence, pregnancy, childbirth and childhood. Care should be streamlined over all consecutive life-cycle stages of mothers and their children, as different stages require different forms of care and services; (2) care should be provided in a seamless manner, between the home, the community, the health center and the hospital. Care is no longer seen only as an entity provided at the health care facility. Care can be optimized by sharing responsibility between health providers, patients and the community.

Following the initial application of the term ‘continuum of care’ in the 1970s [10], the recognition of the two dimensions of the continuum of care has influenced the organization of programs [8, 9]. Since then, the theme has consistently appeared in well-known MCH literature, including the World Health Report 2005 and the Lancet Neonatal Survival Series [2, 8]. The continuum concept aims to reconcile the dichotomies, between mothers and children, places of service delivery, or single health issues [11, 12]. Within the continuum, reproductive health services and care should be accessible to all women before, during and after pregnancy and childbirth, and all babies should be able to grow into children who live and flourish.

An illustration that highlights the importance of MCH is seen in the setting of the Millennium Development Goals. Out of 8 overarching goals, MCH occupy 2 directly: MDG 4 and 5. At the turn of the millennium in 2000, world leaders pledged to reduce the under-five mortality rate by two thirds (MDG target 4A) and maternal mortality ratio by three quarters between 1990 and 2015 (MDG target 5A). These two targets spotlight the mission on MCH that has yet to be realized; despite significant progresses, neither targets was achieved by 2015.

Progress thus far shows that improvements have indeed been made, however much remains to be done in the arena of maternal and child health. Improving MCH remains a top-priority public health issue, despite enduring determination and endeavors.

Why Skilled Birth Attendance and Institutional Delivery?

There are many ways in which skilled delivery is relevant to maternal mortality. One link that connects maternal mortality to skilled attendance is causes of death for maternal mortality. Maternal Mortality is defined as “the death of a woman whilst pregnant or within 42 days of delivery or termination of pregnancy, from any cause related to, or aggravated by pregnancy or its management, but excluding deaths from incidental or accidental causes” [13]. In a study published in 2014 by the World Health Organization, the researchers explored worldwide maternal causes of death through a systematic analysis on datasets from 117 countries [14]. The results reported that top three causes of maternal mortality are Hemorrhage (27.1%), hypertensive disorders (14.0%) and sepsis (10.7%).

Together, these three conditions account for more than half of maternal deaths which are then followed by abortion (7.9 %) and embolism (3.2 %) in the fourth and fifth place respectively. These causes are actually known to have consistently ranked at the top in earlier studies despite slight shifts in ranking orders in each report [4, 15-19]. These causes of death are best handled in a health care setting or at least by a skilled attendant so that she/he can provide required care and/or make referrals if the care necessary for the patient’s condition is outside of her/his capability. The figure 1.1 illustrates the distribution of causes of deaths for pregnant women and mothers and it is apparent that most of the conditions described could benefit from, and should be provided, skilled care. Hemorrhage, which steadily ranks in the top three in maternal causes of death in different settings, is a clear example for this [19].

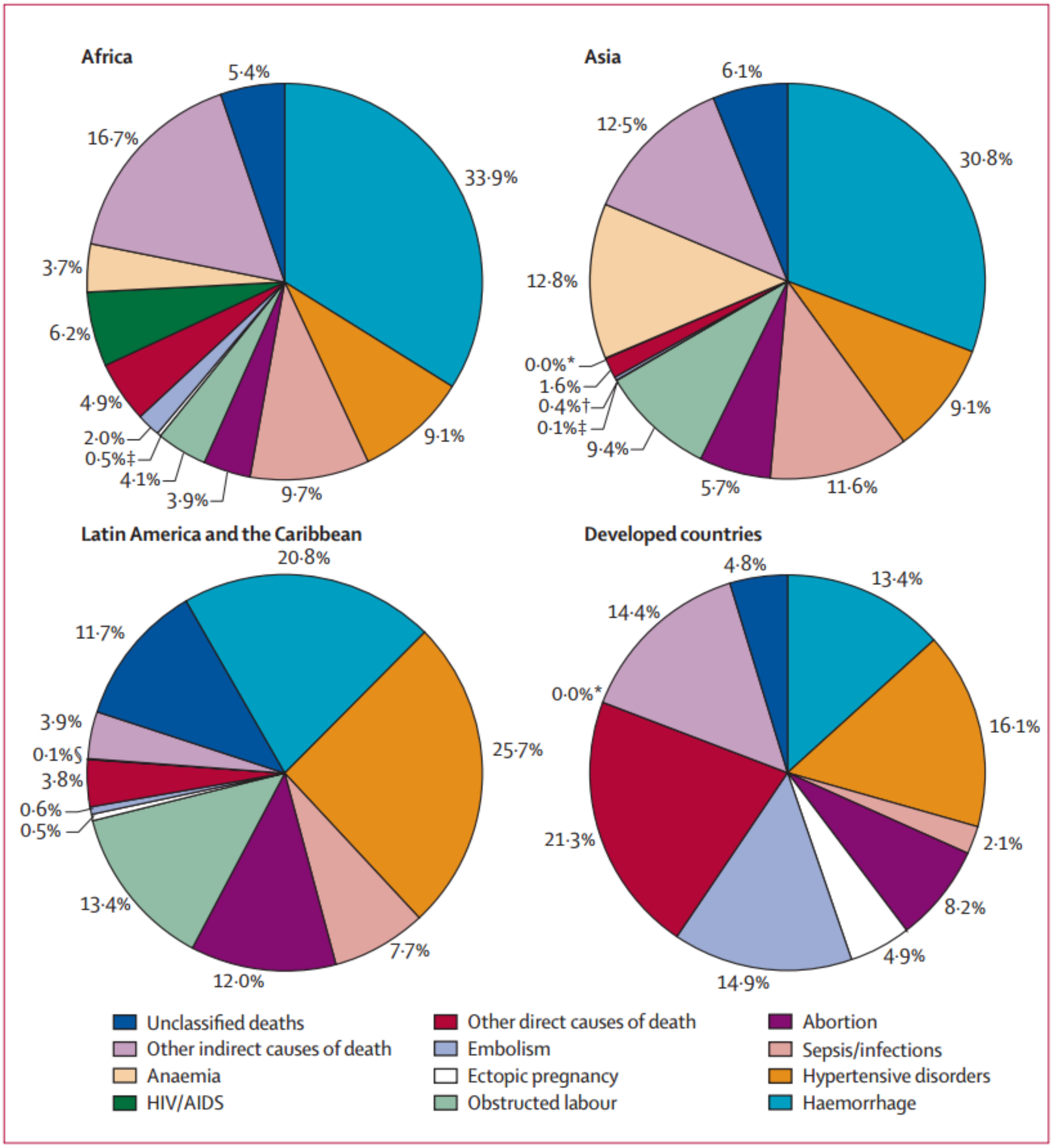


Figure 1.1 Causes of maternal deaths in select regions and developing countries

Historically, there has been a general agreement dating back to the 1980s that skilled attendance is one of the centerpieces in tackling maternal deaths and morbidities [20]. In 1997, the Technical Consultation on Safe Motherhood made a strong statement advocating to 'ensure skilled attendance at delivery' and helped transform skilled attendance into a key proxy indicator for global progress in reducing maternal mortality [21]. The UN Millennium Development Goals two years later incorporated into their maternal health indicators coverage of skilled attendance, together with the maternal mortality ratio [20, 22]. Skilled attendance stood as an important indicator in the MDGs as Indicator 5.5. Following MDG's footsteps in the post 2015 era, skilled attendance continued to be included as indicator 3.1.2. [23] in the Sustainable Development Goals.

Although no single intervention can effectively tackle the wide variety of causes of maternal deaths, institutional delivery is extensively regarded as one of the best options for improving maternal health [24]. Many even proposed that institutional delivery was the single most important strategy in reducing maternal as well as neonatal mortality [25]. The whole premise is based on the idea that facilities that provide maternity services are likely to have trained staff, infrastructure, and standard delivery protocols necessary to handle most complications during childbirth and the immediate post-natal period [26].

The evidence for promoting skilled attendance is somewhat mixed at different levels. At the individual level, for obvious clinical reasons, skilled attendance is called for to ensure safe delivery for not only the mother but also for the child. At least theoretically, the causal pathway is explainable in a straightforward manner [20]. An example of such explanations would be the concentration of deaths around this period, spanning from late pregnancy to 48 hours after delivery, as pointed out by AbouZhar [27]. A study by Graham et al claimed that 16 to 33 % of all maternal deaths can be potentially reduced by skilled attendance through primary or secondary prevention of the common complications such as obstetric hemorrhage, puerperal sepsis, eclampsia and obstructed labor [20].

The causal pathway or explanatory power of skilled birth attendance is less pronounced at the ecological level. The same study by Graham et al. argued that there was a negative association between skilled attendance and maternal mortality at the country level but studies with more vigorous methods focusing at the national level are very limited.

In 2016, WHO formulated a "The Global Strategy for Women's, Children's and Adolescents' Health (2016-2030) for the post 2015 era. In the strategy, WHO advocated for good quality of care at childbirth, which it claims will produce a '*triple return on investment'* – saving mothers and newborns and preventing stillbirths. WHO claimed that if we are able to provide effective care for women and babies at the time of birth in facilities, an estimated 113,000 mothers, 531,000 stillbirths and 1.3 million neonates could be saved annually by 2020, at an estimated total cost of US$ 4.5 billion per year, equivalent to US$ 0.9 per person [28].

Why IMCI?

Integrated Management of Childhood Illnesses (IMCI) is an integrated approach designed in the 1990s to promote child health with a special focus on the overall well-being of the whole child, rather than focusing on a specific condition/symptom of the child. It aims to reduce mortality, morbidities and improve growth and development of children under 5 years of age [29]. It has preventive and curative elements both of which are collaboratively implemented by health workers, families and the community. In health facilities, IMCI promotes accurate diagnosis within outpatient settings, ensures appropriate combined treatment for all major illnesses, improve the counselling of caretakers and facilitate the referral of severely ill children. At homes, IMCI strategy supports appropriate care seeking, improved nutrition and preventive care, and the correct implementation of prescribed care. IMCI ensures all these via a three-component strategy. The three components are

- Improving case management skills of health-care staff
- Improving overall health systems
- Improving family and community health practices[29].

IMCI is usually introduced to countries through a multi-staged process, starting from schematizing an integrated approach to child health and development in the national health policies to strengthening care in hospitals as well as health facilities, and developing support mechanisms within communities. Therefore, IMCI is directly relevant to countries such as Afghanistan which face the need to strengthen their health systems as IMCI can complement health systems strengthening efforts and vice versa.

Another advantage of the IMCI strategy is that it outperforms single-condition approaches [29]. When a child is brought to medical attention in developing countries, it is not uncommon that the child is also suffering from co-morbidities. In such cases, a single diagnosis is inappropriate and impossible. IMCI is designed to combine identification of the child's multiple symptoms for major illnesses as a whole and integrate all necessary treatments. Since it guides the health worker to consider the variety of factors that put children at serious risk, the probability of missing an important condition is also reduced [29].

Also, its clinical guidelines are algorithm-based and concisely describe how to assess, classify and manage children under 5 years who have common illnesses. The guidelines rely on diagnosing cases without laboratory tests and offer empirical treatment. A balance between sensitivity and specificity, using as few clinical signs as possible, has been carefully considered [30]. In fact, both expert clinical opinion and research findings constitute the centerpiece of IMCI guidelines. In developing the guidelines, an extensive technical review of existing program guidelines was carried out with the cooperation of 12 WHO technical programs through the WHO Working Group on Guidelines for Integrated Management of the Sick Child. Experts from programs such as Control of Acute Respiratory Infections (ARI) and the Diarrheal Disease Control Program (CDD), both with the Division for the Control of Diarrheal and Acute Respiratory Disease (CDR), now reorganized as the Division of Child Health and Development (CHD), Expanded Program on Immunization (EPI), the Division of Communicable Diseases (CDS), Action Program on Essential Drugs (DAP), Global Program on AIDS; Maternal and Child Health (MCH): Nutrition (NUT), Oral Health (ORH), Program for the Prevention of Blindness (PBL), and the Malaria Unit, Special Program for Research and Training in Tropical Diseases (TDR) and Control of Tropical Diseases (CTD) collaborated to produce clear and straightforward guidelines. The simplicity and clarity of the guidelines are intended to be exploited by different cadres of health workers with diverse backgrounds, from doctors, medical assistants and nurses to health workers with less training. Consequently, after being trained for a considerably shorter duration for IMCI, frontline health workers can provide an integrated care for children in primary care outpatient facilities [30].

IMCI is strategized to grasp the opportunity to streamline preventive activities with curative care when a child is brought into contact with the health workers for symptoms of sicknesses. IMCI utilizes the health workers' encounter with the sick child as an 'entry point' to provide a spectrum of preventive measures and action-oriented plans. Necessary work is then initiated to change family behavior regarding the child's condition(s).

IMCI implementation can be readily incorporated into wider health system strengthening plans. This is sensible in its own right, given that the successful management of childhood illnesses might be capped by limitations in other aspects of health service infrastructure. For instance, accurate diagnosis and correct treatment alone will not be effective unless corresponding drug supplies are available at the facility. As part of a coordinated vision to overcome such challenges, a course on improvement of drug supply management at first-level health facilities was developed, in addition to the IMCI clinical training course [31]. Also, the effectiveness of IMCI can be enhanced by further building up capacity of hospital care at the referral level via development of guidelines and training secondary care providers. This demonstrates two important notions: (1) the success of IMCI programs should be complemented with wider improvement in other aspects of primary care delivery and (2) countries can grasp the opportunity to snowball wider health system strengthening efforts when implementing IMCI.

2. Chapter (2): Background & Literature Review

Background Information on Afghanistan

The background information partly explains the critical situation of maternal and child mortality and morbidity in the country. It also, to a degree, illustrates the magnitude of the problem and the contextual challenges that could influence the success of the implementation of MCH as well as other health services.

Afghanistan is a land-locked South Central Asian country. It borders six different countries, viz Pakistan, Iran, Tajikistan, Uzbekistan, Turkmenistan, and China. It can be divided into three ecological zones - the central highland, the southern plateau, and the northern plains. Administratively, there are eight development regions - the North Eastern, Northern, Western, Central Highland, Capital, Eastern, South-Eastern and Southern regions. Afghanistan has 34 provinces and 398 administrative districts. Some provinces are newly created after the fall of the Taliban. Districts are further divided into smaller units called villages and municipalities.

The net school enrollment was estimated at 43 percent for boys and 3 percent for girls. Approximately 21,000 marginally trained teachers were providing education for an estimated 5 million school-age population, which gave a teacher to student ratio of 1:240. Since 2002, school enrollment has increased from 1 million to 8.7 million, 36 % of which are girls [32]. Being in the bottom 10 percent globally, the country has one of the lowest rates of electricity usage in the world and only about 38 percent (as of June 2015) of its population is connected to the grid [33].

In 2014, Afghanistan's population was reported by the UNFPA to be 31.3 million with a total dependency ratio of 87% (youth dependency ratio = 82.3%, elderly dependency ratio = 4.6%) [34]. Since the dependency ratio is high, the county can potentially benefit from demographic dividend [35]. The total fertility rate was estimated to be 5.0 with a contraceptive prevalence of 23% (modern methods only).

Partially attributable to the political situation and post-conflict challenges, Afghanistan's health system suffered at almost every level. Compounded by limited availability of resources and instability, the country struggled to provide sufficient inputs to the health system. Health facilities were found to be concentrated in urban areas and more secure rural areas, covering only 40% of the population [33]. 35% of all health facilities had some physical damages to the building caused by war or by earthquake.

Compounded by the very challenging period and other unfavorable contextual factors, important health indicators affirmed the need to improve health services. Life expectancy was considerably low, 47 years in men and 42 for women in 2002. Infant mortality was 165 per thousand live births while child mortality was 275 per thousand live births. Maternal mortality was 1,700 per thousand live births [33]. These indicators were among the lowest-ranked ones globally during that time.

Afghanistan remains as one of the least developed countries and depends heavily on aid. In 2010, its gross domestic product (GDP) at current prices was estimated to be around US$ 17 billion and the GDP per capita at US$572 [36]. GDP annual percent growth has peaked in 2009 at over 20% and has now declined to around 2% in 2014. In 2014, the GDP and inflation stood at US$20.84 billion and 4.6% respectively [37]. Its biggest economic challenge is finding sustainable sources of growth which is a factor in aid dependency. The World Bank alone has contributed $3.09 billion for development projects.

Brief Political History of Afghanistan

Since the establishment of the modern nation-state between 1880-1929, Afghanistan experienced several large-scale conflicts. A few of them were the war of state construction and formation of a central authority between 1880-1901, the war with British India in 1919, the guerrilla war against the Soviet invasion in 1979 which set off a long destructive conflict till 1992, the civil war among the rival *mujuahedeen* factions between 1992-1996 and the ongoing fight against the Taliban [38]. In 2001, a US-led and anti-Taliban Northern Alliance military actions toppled the Taliban government.

Based on the UN-sponsored Bonn Conference in 2001, a new constitution was adopted. A Presidential election in 2004 led to Hamid Karzai becoming the first democratically elected president of Afghanistan who would later on be re-elected again in 2009 for a second term. After many disputes in 2014 election, Abdullah Abdullah and Ashraf Ghani agreed to form the Government of National Unity. Ghani was inaugurated as the President and Abdullah occupied the newly-created position of chief executive officer. The US-Afghan Bilateral Security Agreement and NATO Status of Forces Agreement, both of which were signed immediately after the inauguration in 2014, allowed international military presence in Afghanistan.

Despite the fall of Taliban in 2001 and many political achievements since then, the Taliban remains a serious challenge in almost every province, declaring that they were still in the pursuit of a peace deal which would not be discussed until foreign military forces leave Afghanistan[34]. To this day, many still think of Afghanistan as *terra incognita* [38].

Afghanistan Health Care System

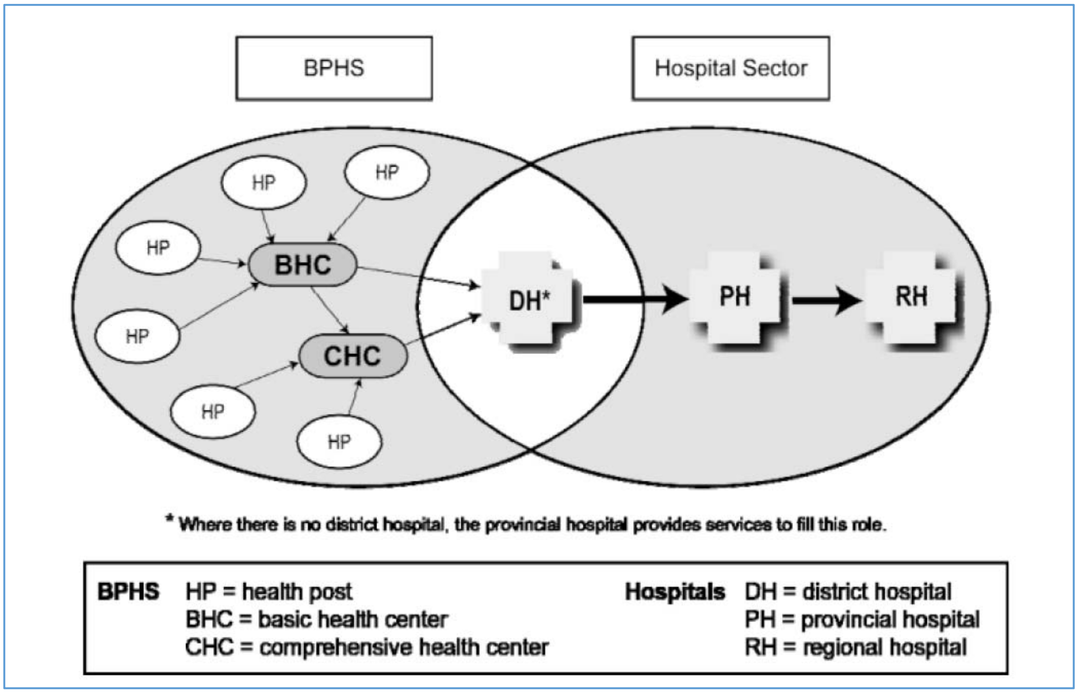


Figure 2.1 Coverage of BPHS and its linkages with Health Care System of Afghanistan

As in many other developing countries, the structure of Afghanistan health care systems is organized in a layered model. At its core stands the implementation of Basic Package of Health Services and Essential Package of Hospital Services. The delivery of care as well as the referral chain ascends from basic community facilities to higher specialized care centers, with health posts being the most basic functional health units and referral hospitals being at the top of the care delivery hierarchy. The facilities along the chain provide both curative and preventive services. Health facilities below the district hospital are generally regarded as primary care services and thus district hospitals can be seen as linkages between primary care and (or gateways to) specialized care services. Figure (2.1) illustrates how BPHS is embedded in the health care delivery structure of Afghanistan.

The table below shows how the maternal services are structured along the health care delivery and referral system network. The table is constructed with a focus on maternal services from a more complete profile of general health services provided at different levels of health care delivery described in two official documents prepared by the Ministry of Public Health in Afghanistan [39, 40]

A more detailed profile of general health services provided are attached in the Annex.

Type of Facility	Population Coverage (number of beds)	Staff	Functions and remarks
Health Post (HP)	1,000 - 1,500	male & female community health workers (CHWs)	CHWs are not considered as health professionals but received focused training Not considered as skilled birth attendants
Sub-center (SC)	2,000 - 15,000	a male nurse a community midwife	To expand service coverage to remote hard-to-reach areas
Basic Health Center (BHC)	15,000 - 30,000	a nurse two vaccinators a community midwife	Out-patient antenatal care Delivery care Out-patient post-partum care IMCI TB treatment
Comprehensive Health Center (CHC)	30,000 - 60,000	male & female doctors male & female nurses female midwives lab & pharmacy technicians	Wider range of services than BHCs Inpatient care Lab Basic emergency obstetric care Blood transfusion services (but no blood banks)
District Hospitals (DH)	100,000 - 300,000 (25 - 75 beds)	a general surgeon an Ob/Gyn an anesthetist a pediatrician midwives lab & x-ray technicians a pharmacist	All BPHS & EPHS services Comprehensive emergency obstetric care including Caesarean surgery
Provincial Hospitals (PH)	(75 - 250 beds)	3 Ob/Gyn 2 pediatricians 2 anesthetists + other specialists & staff	Same clinical services as DH but More sophisticated equipment More advanced care Referral to Regional hospitals
Regional Hospitals (RH)	(300 - 450 beds)	5 Ob/Gyn 4 pediatricians 3-4 anesthetists	Same services as PH Special surgical, lab & imaging services 4 RHs in Afghanistan (Balkh, Herat, Kandahar & Kunduz provinces)
National Specialty Hospitals (SH)			Highest Level of tertiary care All located in Kabul City 2 specialty maternity hospitals in Afghanistan 2 national general hospitals

Table 2.1 Hierarchy of Health Services (Public) in Afghanistan with a focus on Maternal Health [39, 40]

Maternal and Child Health in Afghanistan

Maternal and child health in Afghanistan used to be a dire situation a decade ago. It was reported that the entire country of 23 million population had only 467 midwives, with significant variation in their capacity. There was only one female nurse per 470,500 population in Ghor province [41]. Basic reproductive health services (antenatal care, deliver care, post-partum care and family planning services) as defined by Basic Package of Health Services was available in 17% of 783 BPHS facilities. Only 62% of the facilities had a minimum set of equipment necessary to provide antenatal care. UNICEF highlighted in 2002 that Afghanistan is one of the worst places to be pregnant [42]. Half of BPHS facilities were not providing delivery care [43]. Although the most common cause of maternal death in the country is blood loss during pregnancy and delivery, only 32% of national, regional or provincial hospitals had the capacity to offer blood transfusion and the lab services to group and match blood types. A survey jointly done by the Indian Institute of Health Management Research and Johns Hopkins Bloomberg School of Public Health in 2003 reported that less than 10% of births were cared for by a skilled birth attendant [44].

On the positive side, the situation provided an opportunity to gather up a collective effort to strengthen the health system. The alarming condition was translated into widespread consensus among key players and stakeholders that rebuilding and strengthening of the health system should be given top priority. This effectively initiated the implementation of Basic Package of Health Services (BPHS) and Essential Package of Hospital Services (EPHS). Recognizing the role of primary health care and acknowledging its limited institutional capacity to provide health care with a depth and breadth sufficient to meet the urgent need of the country's health sector, MOPH oversaw the contracting of health services to different NGOs. BPHS package was contracted to primary care facilities in 2003, followed two years later by EPHS which was contracted for district hospitals, regional hospitals and national specialty hospitals. Together, BPHS and EPHS formalized the complete referral chain, standardizing care packages by defining the number and type of staff that should be employed, the services and equipment that should be present, the items of drugs and supplies that should be stocked at different layers of health care 'outlets.' Both BPHS and EPHS rank maternal and child health services at the top of their priorities. National Reproductive Health Strategy formalized in 2006 explicitly stated its goal to be "to develop the health sector to improve the health of the people of Afghanistan, especially women and children, through implementing the Basic Package of Health Services (BPHS) and the Essential Package of Hospital Services (EPHS) as the standard, agreed-upon minimum of health care to be provided at each level of the health system" [45].

At the time of rolling out in 2004, MOPH implemented BPHS in 31 provinces out of 34 provinces through contracts to NGOs and in the remaining 3 provinces via direct management. The financial support for implementation came from United States Agency for International Development for 13 provinces, the World Bank for 11 provinces and the European commission for 10 provinces. These donors also provided technical assistance [46].

Also, there were multiple simultaneous efforts to strengthen nationwide capacity to provide better care. To complement EPHS efforts, a hospital reform project was introduced by MOPH. The goal was to improve the quality of health care provided at the hospitals through capacity development of staff including management, improving organizational processes and formulating sustainability for the future. MOPH realized the pivotal role of midwives in improving maternal health. In order to train new batches of midwives, 2 pre-service training programs were established. These programs focused on developing skills in midwives to fulfil the needs they will encounter when they function in community and hospital practice. The programs were supported by the same donors that supported BPHS and EPHS. Acceleration in midwifery capacity building can be pointed out through certain milestones achieved over the years. Since the undertaking of BPHS in 2004, 5 Institutes of Health Sciences programs and 29 community midwifery schools had been founded in 31 provinces [47].

Supported by the USAID-funded ACCESS and Health Services Support Projects, the Afghanistan Midwives Association (AMA) was formed in 2005, to support the increasing number of midwives and to foster the profession through advocacy and education. The association started out with a modest number of 80 members but now has more than 3,000 professional midwives from all 34 provinces in the country [48]. The AMA was accredited by the International Confederation of Midwives in 2006. In 2012, the Organization of Afghan Midwives was established. It is currently functioning as a midwifery-led, non-political, non-governmental national organization with the primary objective to implement programs that build the capacity of midwives and increase access to quality midwifery services [49]. In 2010 there were 32 midwifery schools nationwide but the number of schools had decreased to 22 in 2013 due to funding challenges [50]. The new System Enhancement for Health Action in Transition Program is envisioning the number of midwifery schools to be increased to 31 by 2018. To date, 4,600 midwives have been trained by the two programs. Midwives are thought to be instrumental in reducing Afghanistan's maternal mortality ratio over the years. MOPH stated that the population coverage by the private sector health service was estimated to by around 85 percent [40]. The Afghan Mortality Survey conducted in 2010 estimated that 34 percent of all births were attended by skilled providers. Midwives accounted for 20 percent of these skilled births [51]. The National Risk and Vulnerability Assessment survey 2011-2012 reported that the proportion of births attended by skilled health personnel was 39.9 percent (MDG indicator 5.2). Women in urban areas are twice as likely to be assisted by skilled birth attendants as rural women (75 percent compared to 33 percent). The figures closely echoed the percentage of women with institutional deliveries which stood at 36 percent (urban = 69%, rural = 29%) [52]. The Afghan's Midwifery 2014 report mentioned that 3,500 midwives and 400 obstetricians/ gynecologists were working full time on maternal and newborn health while 4,200 physicians/ generalists were contributing 12% of their effort to MNCH services in 2012 [53].

These investments among other implementations improved the delivery of maternal care in the country. Consequently, progress was seen in outcomes and impact indicators. Population studies estimated an increase in skilled delivery from less than 10% in 2003 [54] (rural = 6%, urban = 35%), 19% in 2006 [55] (rural only) to 34 % in 2010[51] (rural = 26%, urban = 71%). In pace with improvements in outcomes, impact indicators also grew better. Table (2.2) shows the trend in the maternal mortality ratio in Afghanistan from 1990 to 2013 for select years.

Year	Maternal mortality ratio (MMR)	Maternal deaths	Number of AIDS-related indirect maternal deaths	Live births[a]	Proportion of deaths among women of reproductive age that are due to maternal causes (PM)
	Per 100 000 live births (lb)	Numbers	Numbers	Thousands	Per cent
2013	400 [220-750]	4,200	1	1,045	17.9
2005	730 [390-1400]	8,100	1	1,109	34.7
2000	1100 [560-2000]	11,000	1	1,042	49.4
1995	1200 [640-2300]	10,000	0	858	47.7
1990	1200 [640-2400]	7,900	0	652	43.2
Annual % change					
1990-2000	-0.9				
2000-2013	-7.5				
1990-2013	-4.7				

Table 2.2 Maternal mortality in Afghanistan from 1990 to 2013 [56]

UNICEF reports that Afghanistan showed significant reductions in under-5 (U-5) child, infant and neonatal mortality respectively from 176, 120, and 50 in 1990 to 97, 70 and 36 per 1,000 live births in 2013 [57]. Despite such achievements, Afghan children's mortality and morbidity remained among the highest in the Region. More than half (54%) of deaths among U-5 children in Afghanistan were caused by only three diseases such as diarrhea (20%), pneumonia (28%) and measles (6%) [57]**Error! Bookmark not defined.**.

As part of the effort to tackle the situation, Integrated Management of Childhood Illnesses was introduced in 2003 as an integral component of Basic Package of Health Services with technical support from WHO and UNICEF. The expansion phase started in 2004. By 2014, around 4,199 health providers (doctor, nurse and midwife) and 14,390 CHWs were trained on IMCI case management (facility level) and CIMCI (community level) [58].

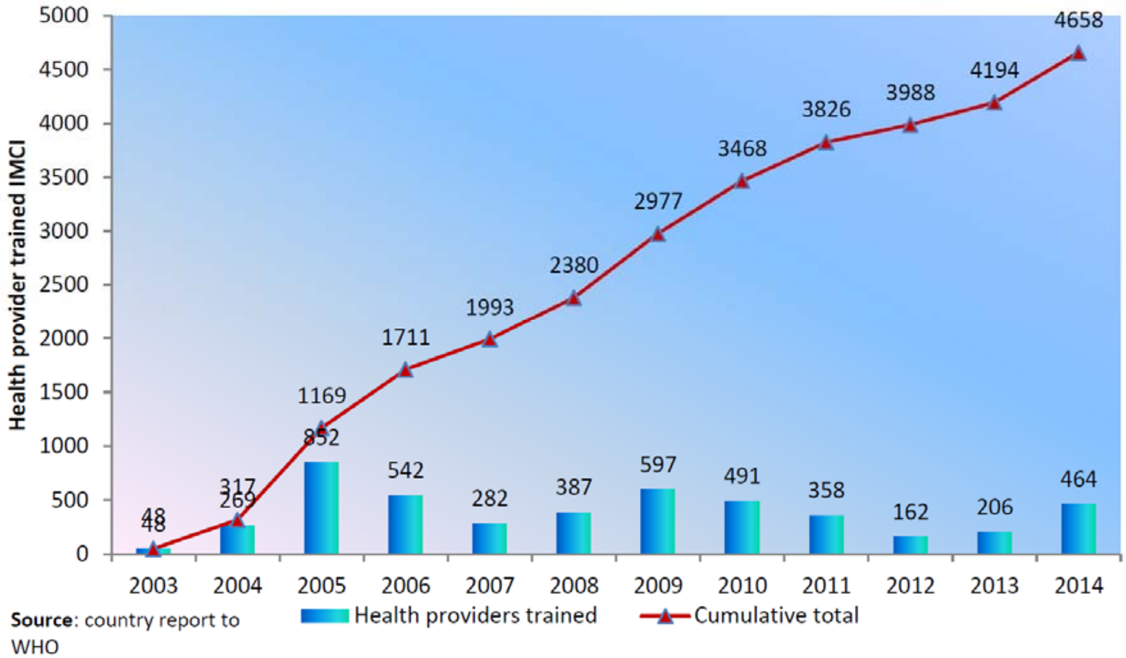


Figure 2.2 Health Providers Trained in IMCI by Year [58]

Despite these training efforts, a study revealed that only about two thirds of children were cared for by trained health workers and about half of them were examined and treated by health workers who were trained during the recent four years [58]. The same study reported unreliable supplies of basic equipment and lack of essential medicines such as pre-referral antibiotics. It also highlighted that IMCI guidelines adherence by health providers was not optimal and thus the quality of care provided to the sick child suffered. It was found that inaccurate classification of the illness in the child was often made, along with overlooking of signs of moderate and severe conditions. Although correct prescriptions were made, the correct dose of treatment is not always guaranteed. First doses of drugs were rarely given to the child at the facility. Challenges in quality of care were also found in counselling. Although IMCI counselling was designed to be comprehensive, key message such as ‘continue giving liquid’ and ‘continue feeding the child’ were provided in only about a third of the children in Afghanistan.

Evidence for Increasing Utilization of Health Services for Delivery by Mothers

Determinants of skilled attendance at birth were explored by a few studies in Afghanistan and many studies elsewhere.

Looking beyond the context of Afghanistan, maternal education is a widely popular determinant of skilled attendance. Studies in Indonesia [59], Vietnam [60], China [61], Ethiopia [62], Botswana [63], Turkey [64], Tajikistan [65], Bangladesh [66, 67], Nepal [68], India [69, 70], Peru [71] and Guatemala [72] reported a consistent finding that maternal education was associated with skilled attendance. The findings from these studies suggested that women with primary-level education are more likely to be attended at birth by skilled worker than women with no education.

Another determinant was age. Women older than 35 years and younger than 19 years were found to be more likely to seek skilled care for child birth. These age groups were considered to be at higher risk in comparison with other age groups. Parity was also found to play a role in utilizing delivery care but the evidence was mixed. A negative association between parity and utilization of skilled attendant was found in studies from India, Ethiopia, China, Indonesia, Vietnam, Nepal, Peru and Turkey, i.e. the higher the number of the pregnancies, the lower probability that the women would use safe delivery [59-62, 64, 68-71]. An opposite association was found in a study from Botswana by Letamo et al. [63]. The research reported that women with 5th pregnancy and above were more like to use skilled attendance than women of lower parity. Inconclusive findings were reported in researches conducted in Bangladesh [66] and Zimbabwe [73].

The other determinant was knowledge of caretakers/mothers on risk factors and danger signs of severe complications. A study in Zambia found that such knowledge was associated with mothers accessing skilled care [74]. Li from China asserted that exposure to the outside world, including travel experience and exposure to mass media, was associated with consultation with a health worker [61]. A North Indian Study found a strong association between freedom of movement, which was considered a dimension of autonomy, and skilled attendance during delivery [69]. The same study however reported no association between skilled delivery and other dimensions of autonomy such as control over finances and decision-making power.

The other individual-level factors affecting the use of skilled care at birth included complications experienced during previous pregnancies and use of antenatal care [75].

Household characteristics were also studied. Socio-economic status was one of the top characteristics studied. Studies by and large regularly report that rates of utilization of general health services was lower among the poor. This was also true for utilization of skilled attendance; existing knowledge points toward a positive association between household economic status and skilled attendance. Likewise, husband's education seemed to have an effect but its effect was weaker than women's education. Location of household also played a role. Women from urban areas were more likely to use safe delivery care than those from rural areas [75].

Although many studies were conducted on demand side characteristics, few studies looked at supply side factors, especially quantitatively. In qualitative studies, barriers to utilization of services were often reported to be travel distance, cost and quality of care [75].

Very few studies reported quantitative associations between quality of care and utilization of care. The quantitative component of a mixed study in Zimbabwe reported a proxy measure of quality of care such as availability of supplies as a barrier to utilization. However, the same study reported there was no association between one measure of perceived quality and utilization of delivery services [73].

A literature search returned many studies that looked at determinants of quality of care in different settings. These factors have provided clues to policy makers on how to improve the quality of care. However, the literature search did not return many researches reporting the quantitative effect of improvement of maternal health quality on utilization of skilled care during delivery.

In the context of Afghanistan, a similar pattern was found in the existing literature: while there were a number of studies on determinants of quality of care, few studies examined at the association between quality of maternal care and utilization of skilled attendance. A study done by Viswanathan et al. found that increased skilled attendance during delivery was associated with the presence of a community health worker in the community, mother's education level and household economic status [76]. An evaluation study done in 2008/09 for the pre-service midwifery training program reported a finding which suggested the presence of new midwives contributed to an increase in skilled birth attendance [77]. Neither of the studies looked at quality of care as determinants of utilization.

A study by Hansen reported factors influencing quality of primary health services in Afghanistan. NGO-managed health facilities have higher quality scores of recurrent inputs and management processes than government-managed facilities. However, there was no difference for the quality of clinical processes. The only recurrent input found to be associated with variations in quality of clinical processes was the number of supervision visits. Patients from lower socioeconomic status were found to receive poorer service quality. This was only true for government-managed facilities. There was no difference in service quality between male and female providers, nor between male and female patients. Interestingly the study reported high quality if both the provider and patient were females. However, Hansen's study focused on the quality of general primary care, rather than maternal care specifically [75].

Arur reported in a 2008 study how utilization of services in Afghanistan were influenced by contracting approaches. She examined general primary care outpatient utilization rather than maternity-specific care. The study concluded that contracting-out and contracting-in of services to/from different NGOs had been effective in promoting service utilization, including by women and the poor [78].

A 2010 study analyzed determinants of access to primary health care in rural Afghanistan, focusing on geographic and financial factors. Geographic access as measured by household's reported travel time to the nearest facility had a strong association with care seeking for children. User fees were found to act as a barrier to utilization. At the same time, fee waiver cards distributed to vulnerable households were associated with increased likelihood of accessing care when sick and with using facility delivery services. Again the study did not inspect the effect of quality of care on access to care [79].

A study in 2014 looked at determinants of skilled birth attendance. Individual level characteristics (women's age, highest education level completed, literacy, household wealth status, gravidity, history of pregnancy loss, prior antenatal care visit, who made the decision about place of delivery), health facility characteristics (donor agency supporting BPHS services, contracting mechanism, number of functional health facilities, agency responsible for service delivery) and provincial characteristics (overall provincial health performance score, percent of health system performance targets met) were explored. Out of these factors, only certain individual characteristics which are mother's education, women in the upper two quintiles of household wealth and women with at least one antenatal visit were found to be associated with skilled birth attendance [80].

In summary, the knowledge on the association between structural quality of services specific to pregnant women and utilization of facility-provided delivery care in Afghanistan is still nascent.

Improving quality of IMCI services and exploring its determinants

Since its conception, countries have progressively accepted the IMCI strategy. The IMCI approach has been adopted in more than 100 countries to save the lives children under 5 years [81]. Given the widespread implementation of IMCI all over the world, several studies have looked at how IMCI quality can be improved. This, among other things, involves health worker performance and identification of factors that are associated with it.

The literature review shows that earlier studies regarding IMCI focused on the effect of IMCI, i.e. whether IMCI was effective (the impact of IMCI program efforts on health/health indicators) and efficient (whether IMCI was cost-effective). This was perhaps because evidence was needed to decide whether IMCI was the right strategy to tackle common childhood diseases. Most studies showed that

IMCI was effective and efficient, not only in bringing up quality but also in reducing mortality and morbidities [82-87]. Later, studies shifted focus to investigate how better quality of child care can be orchestrated through IMCI implementation. This is to understand how best to bring about the right strategy and implement it.

The Multi-Country Evaluation of IMCI effectiveness, Cost and Impact (MCE) gathered evidence from 5 countries, Uganda, Tanzania, Peru, Brazil and Bangladesh. All the sites included in the study reported that improvements in quality of care received by children was seen in settings where Ministries of Health had trained health workers in IMCI case management. They also reported that mortality was lower in IMCI districts when compared to control districts [83, 85, 88-90]. IMCI can also improve the quality and efficiency of child health care relative to routine child health care. Bryce et al. found that better child health care was associated with IMCI training at no additional cost to districts [91]. Similar findings that IMCI improved delivery of better child care were found in a study in South Africa [84].

In the discourse of health care delivery, management of a disease or a condition means at least two things: (1) a health care provider must reach at a correct diagnosis based on symptoms & clinical examination, and (2) correct treatment should be advised and/or provided given the diagnosis. A number of more recent studies looked at IMCI from this point of view, attempting to identify individual- (provider as well as patient/caretaker), facility- and provincial-level factors that can influence the quality of the diagnosis and/or treatment of childhood illnesses. Rowe et al. studied significant predictors of correct treatment in the Central African Republic from a sample of clinical consultations of children with malaria. They reported that correct treatment was associated with high fever, correct health worker diagnosis, care giver's reporting the child's fever to the health worker and longer consultation time. Neither in-service training for the treatment of fever nor supervision was significantly associated with correct treatment. There was also a surprising finding that the presence of a fever treatment chart was negatively associated with correct treatment [92].

As regards in-service training, a study in Nigeria reported that it was associated with correct treatment of ARI and diarrhea[93]. Studies in Afghanistan reported findings favoring training for IMCI [94, 95]. While there were more studies claiming that there was an association between quality of child health services and in-service training than those that do not, a study in Bangladesh looked at the effect of duration of pre-service training on quality of care. The study asserted that training length might not be a determinant of quality of care, highlighting that there was no significant difference in the quality of management of under 5 patients between health workers with 18 months pre-service training and those with 4 years. A study in Egypt purported that perceived quality of MCH services was affected by waiting time as well as the environment of the clinic [96].

In the context of Afghanistan, studies have identified determinants of the quality in delivering the Integrated Management of Childhood Illnesses. In a study published in 2009, it was described that improved IMCI quality score could be linked to presence of clinical guidelines and frequency of supervision. The same study looked at clinical assessment quality and counselling quality separately. An assessment index was found to be related to both supply-side and demand-side factors. On the supply side, the cadre of providers, providers with higher knowledge score, providers with IMCI training in the past were providing better quality services. Also, longer consultation time was reported to improve quality. Another factor affecting IMCI capacity was contracting mechanism. Facilities that contracted-in services were able to provide better quality services. Client characteristics were also at play. Younger children and children brought in by female caretakers were better assessed by health care providers in the facilities. In terms of counselling quality, the same factors underscored the quality of services except types of health workers and the age of the child[94]. Another study was published in 2012 focusing on health workforce capacity and pediatric care quality. It confirmed most findings from the previous study while describing new factors that were found to be statistically significant. Health workforce variables such as availability of doctors and provider job satisfaction were reported to be positively associated with quality of care. Support and supervision mechanisms were also related to quality observed in the clinic. Presence of clinical guidelines in the facility was correlated with better quality. Frequency of supervision and presence of community councils (Sura-e-sehie) were also significant factors.

One of the aims of this study is to examine IMCI quality determinants in the context of Afghanistan. Factors such as types of health facilities (basic health center, comprehensive health center, subcenter, health post), sex of health worker, how long ago the health workers were trained for IMCI (within a year, more than a year, not at all), and volumes of health services will be explored in relation to quality of assessment and treatment. The effect of duration of time spent in clinical encounter on the proper assessment and treatment will also be examined. Previous studies did report an association between the two but a dose-response relationship was not explored. Dose-response analysis also has the potential to suggest the length of time that should be allotted for each clinical encounter to be able to deliver optimal quality of care to children. In analyzing the factors described above, the study will draw on results from previous researches. Previous studies will inform at least in two areas (1) in controlling for potential confounders and (2) in identifying the need for effect modifiers.

To sum up, many studies were done in the past on determinants of IMCI quality in general but few studies have specifically and separately looked at determinants of process quality of care for ARI and diarrhea in the context of Afghanistan. Knowing the factors associated with process quality of diagnosing and managing these top killer childhood diseases will add to the current understanding of how to improve IMCI implementations. This study aims to fill the gap adding granularity to the knowledge base.

3. Chapter (3): Conceptual framework & Study Aims

Conceptual Framework

The conceptual framework used in this dissertation is based on and adapted from two conceptual models: (1) a conceptual model for evaluating the scale-up of maternal and child survival put forward by Bryce et al. [97] and (2) Donabedian's Structure-Process-Outcome approach to quality of care [98].

Bryce et al.'s framework is blue-printed on the input-process-output-outcome-impact pathway (See Annex for the original framework of Bryce et al.). The input-process-output-outcome-impact pathway is deemed part of a systems approach to health care [99]. The framework highlights the results of health care, and how these are obtained at the national level, thus It can be regarded as a macro-level framework. Since the primary aim of any health system is to achieve better health of the people, the framework is relevant to the current research in the sense that it can illustrate how health system strengthening implementations in Afghanistan are affecting the health of its people. What makes the framework even more relevant to this dissertation is that Bryce et al. framed the health systems components in the perspective of maternal and child health services. The framework identifies, in pursuit of improvement in MNCH services, what could be put into health systems, what processes could be undertaken, and what the expected results are. The inputs and processes described in the framework mostly cover the systems building blocks of the widely known WHO health system model [100].

Inputs are generally the resources needed for health care. To include maternal and child health, inputs should include reasonable financial and human resources, and well-thought out plans and policies. Processes demonstrate the use of inputs, and the activities within the system brought about by utilizing the inputs. The outputs are immediate results of inputs and processes. Outputs lead to outcomes, which in turn produce impact. Since this framework is at a macro level, the impact is based at the population level. Furthermore, since this is MCH-oriented model, everything, ranging from inputs to impacts, is focused on maternal and child health related variables.

The input-process- output-outcome-impact continuum does not operate in a vacuum, it is under the forces of contextual factors. The contextual factors range from general political, economic, and social factors to more specific epidemiological factors, such as maternal mortality rates, child mortality rates, and prevalence of conditions which can affect the health of the mother and her child or children, all of which can influence the effect of interventions, either directly or indirectly, positively or negatively. Thus, contextual factors may be considered enhancing or inhibiting factors for maternal and child health implementation.

One of the output variables in the Bryce et al.'s framework is the quality of care, around which the whole premise of this dissertation revolves. The framework describes which factors contribute to the quality of care, and their relationships to each other. However, Bryce et al.'s original framework does not explicitly separate structural, process and outcome aspects of the quality of care. This limitation calls for the integration of a model which can accommodate such important separations; the unification with Donabedian's model is an endeavor to fill this gap.

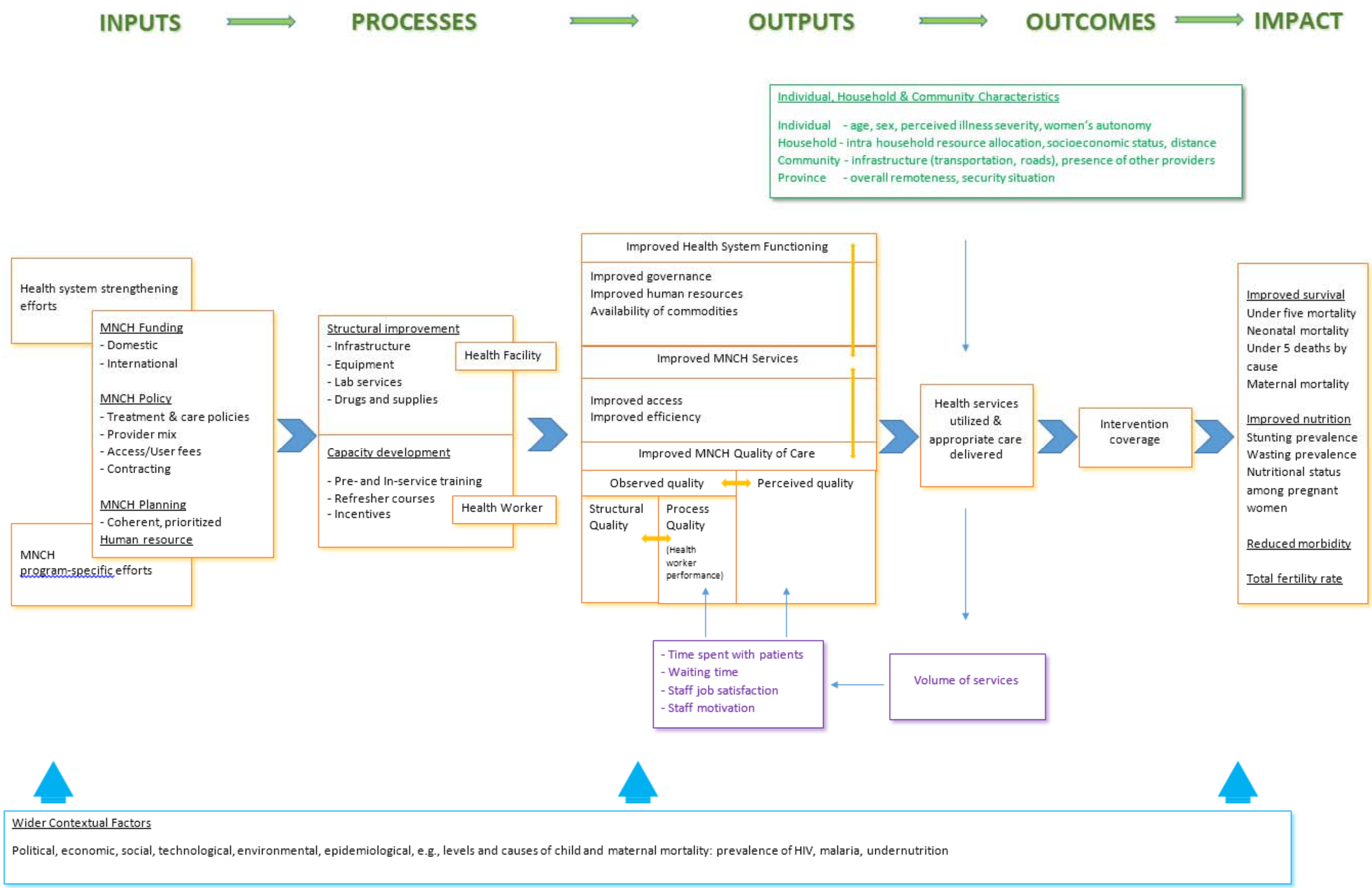


Figure 3.1 Conceptual framework used in the dissertation

In his three-part approach to quality assessment, Donabedian defines structures as the attributes of the setting in which care occurs. The attributes range from material resources to human resources and organizational structure. Process represents what is actually done in giving and receiving care. This starts from the patient's activities in seeking care, to the health worker's activities in making a diagnosis and recommending or implementing treatment [98]. Outcome refers to the effects of care on the health status of individual patients as well as populations. Donabedian's model defines outcomes broadly, to include improvement in disease status, patient's knowledge, changes in behavior, and the patient's satisfaction with care. In his model, the structure, processes and outcomes are strung together by a central assumption that good structure increases the likelihood of good process, and good process increases the likelihood of good outcomes in terms of quality of care.

The quality of care explained by Donabedian's model is generic; there is no specification on whether it is primary or specialized care, MCH or non-MCH care. This characteristic can be both a strength and a disadvantage. The strength is that the model can be applied to any type of care provided in any type of settings. The disadvantage is that the model lacks the necessary elements to explicate delivery of care specific to MCH. In the conceptual framework chosen for this thesis, this limitation is addressed through integration with the MCH-specific framework by Bryce et al..

Incorporating Donabedian's model into Bryce's et al. framework adds the granularity necessary to examine the quality of care provided at facilities by health workers, and enables further categorization of the quality of care into structural and process quality, aspects which the study will examine separately.

Quality of MCH care is the main interest of the study. SA (1) will look at structural quality and SA (2) will investigate process quality. The adapted framework can describe both variables and their relationships with other variables. The SA (1) explores the effects of improving quality of MCH services on utilization while SA (2) examines the effect of process quality on accurate diagnosis. Since the framework includes pathways showing how quality can be improved, and the effects of improving quality, (considering both structural and process quality), the framework can guide both SA (1) and SA (2). Consequently, the choice of explanatory variables and other covariates, included in the mathematical models in SA (1) and SA (2), are based on the framework. The pathways and variables of interests in SA (1) and SA (2) are specified and highlighted separately for each SA in the following section.

The SA (1) will look at the health facility level to examine structural quality through a composite measure. The framework will guide the identification of items that can be included into the composite measures at the facility level. The chosen framework shows that infrastructure, equipment, lab services, and drug supplies, are all part of structural quality, and these variables will be used when constructing the structural quality composite variable. The framework depicts that improving the quality of care is not the sole determinant of utilization of health services; a myriad of other factors also contribute. Utilization of health services can also be affected by individual characteristics such as age, sex, perceived illness severity, and women's autonomy; household characteristics such as intra-household resource allocation, socioeconomic status, distance between household and the health facility; and community and provincial characteristics such as transportation infrastructure, presence of other providers in the community, overall remoteness and security. Therefore, the framework will be used as a guide in controlling for these factors, (provided that data are available for these variables), when examining the relationship between quality and utilization for maternal services.

The SA (2) explores the extent to which accurate diagnosis depends on process quality in examining the patient. The framework describes potential factors that can influence the process quality of delivered care, and how they can lead to delivery of appropriate care. This approach aids in the selection of potential variables for the analysis. Moreover, the framework shows the relationship between these factors, which serves as a basic blueprint for the mathematical models in our analysis.

To take the utility of the framework of choice a step further, it is contended that there is a possibility that the framework will be useful in formulating appropriate policy recommendations. Based on the findings from analyses of SA (1) and SA (2), policy recommendations will be synthesized. With the framework as a backdrop, we may be able to anticipate certain effects of such policy recommendations. For example, if the findings from SA (1) demonstrate that improving quality is associated with utilization, the framework describes that increased utilization also effects waiting time, i.e. increased utilization of services can lead to longer wait times at the health facilities. Therefore, increased utilization can have an (undesirable) effect on perceived quality. This framework can help implementers think about unintended consequences of our policy recommendation, and the actual implementation.

Study Aims

Study Aim (1): To study and quantify the association between changes in the structural quality of maternity services and number of institutional deliveries across provinces of Afghanistan

This Study Aim seeks to explore if there is association between improvements in maternity services quality over time and the numbers of institutional deliveries in Afghanistan.

<u>*Null Hypothesis:*</u> *There is no association between improvements in the observed* facility level composite measure of structural quality of maternal health services from NHSPA observations *and changes in number of institutional deliveries in provinces of Afghanistan from 2004 to 2012.*

<u>*Alternative hypothesis:*</u> *Improvements in the observed* facility-level composite measure of structural quality of maternal health services from NHSPA observations *are associated with changes in number of institutional deliveries in provinces of Afghanistan from 2004 to 2012.*

The pathway of interest for SA (1) is highlighted in blue in the conceptual model.

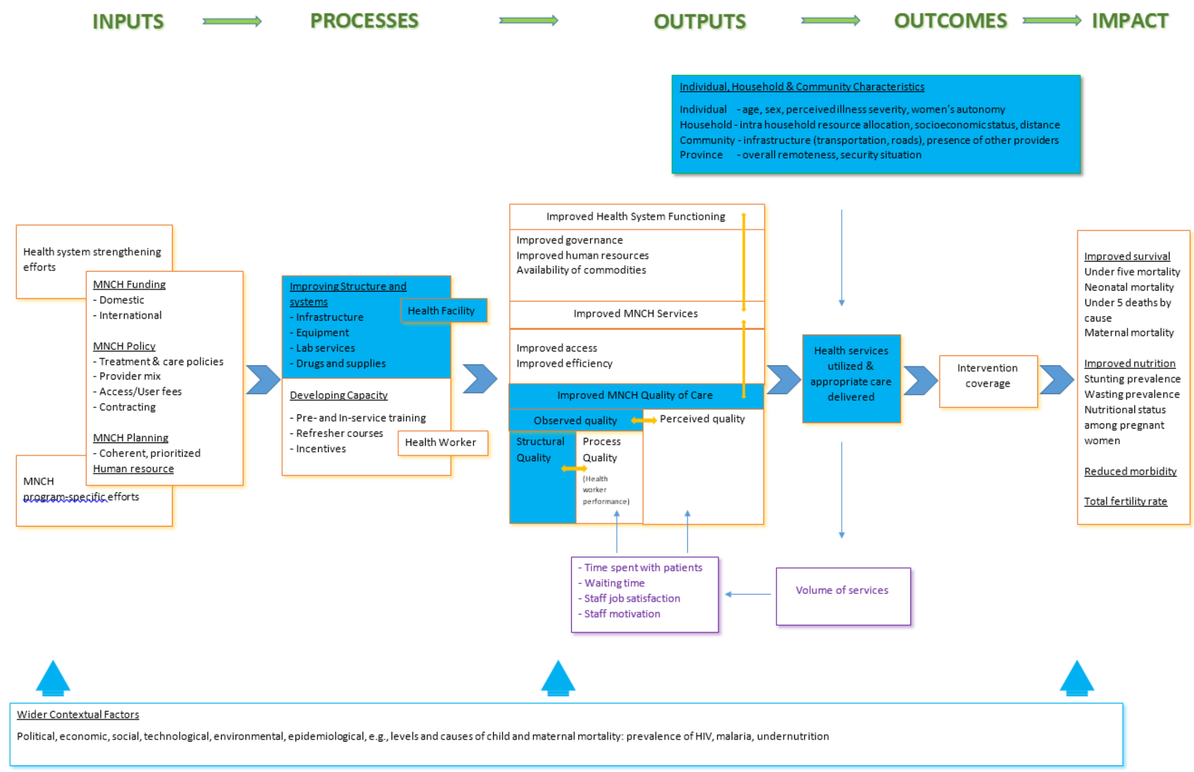


Figure 3.2 Conceptual Framework showing the pathway for SA (1)

Study Aim (2): To study and quantify the relationship between health workers' ability to adhere to clinical guidelines for children under 5 years presenting with symptoms related to ARI & diarrhea and the health workers' ability to provide accurate diagnosis.

The SA (2) seeks to determine if health workers who follow the IMCI guidelines in examining children less than five years old, are more likely to give a correct diagnosis regarding two childhood illnesses, namely ARI and diarrhea, (both of which play a crucial role in childhood mortality), than health care workers who do not follow the IMCO guidelines. In other words, SA 2 will explore how much getting the right diagnosis depends on providers' compliance with a clinical algorithm, after controlling for certain individual, facility- and provincial level characteristics.

<u>Null Hypothesis:</u> *There is no association between health workers' adherence to clinical guidelines and the likelihood of reaching at a correct diagnosis for children under 5 presenting with ARI and diarrhea symptoms.*

<u>Alternative hypothesis:</u> *Health workers' adherence to clinical guidelines is associated with the likelihood of reaching at a correct diagnosis for children under 5 presenting with ARI and diarrhea symptoms.*

Study aim (2) is guided by the pathway shaded in blue in the conceptual model.

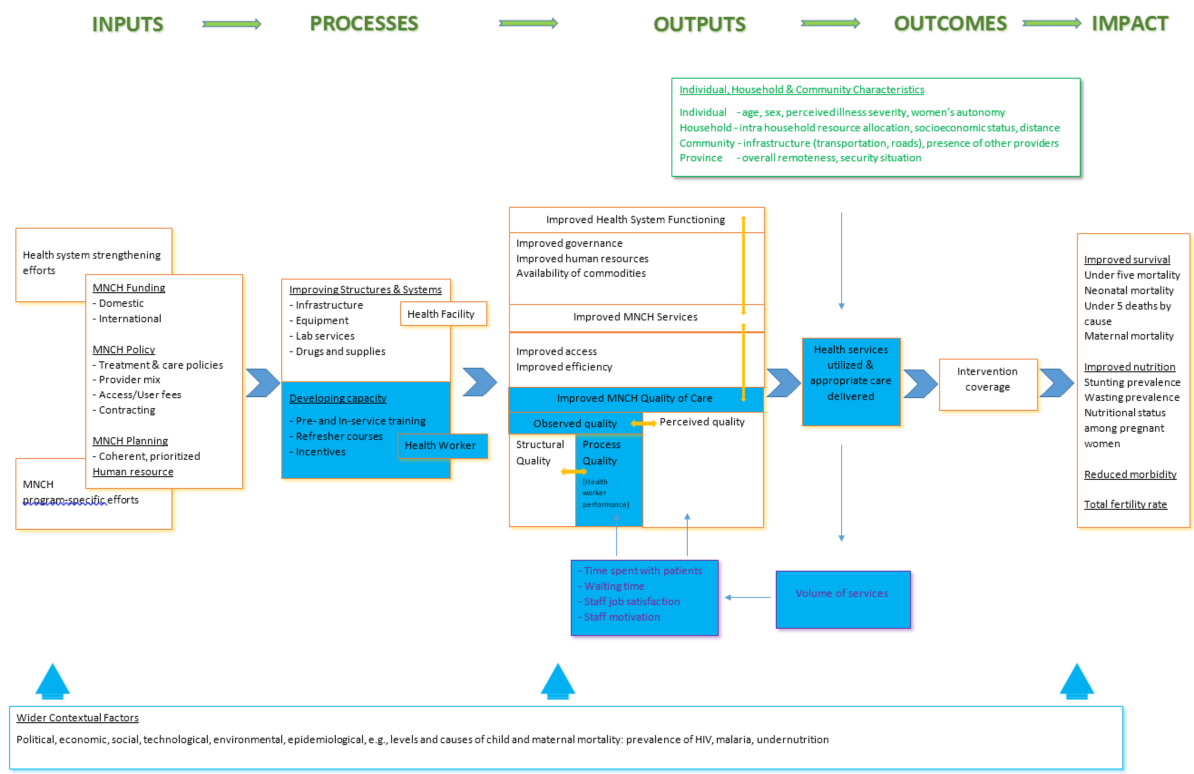


Figure 3.3 Conceptual Framework showing the pathway for SA (2)

4. Chapter (4): Description of Data

Overview of Data Sources

Implementation of the Basic Package Health Services and Essential Package of Hospital Services in Afghanistan came with the need to monitor and evaluate its progress. Given the lack of a functioning health information system, in 2003 the MOPH of the country decided to initiate an annual assessment of health services provided nationwide.

In 2004, the MOPH conducted the first National Health Services Performance Assessment (NHSPA) with independent technical support. Since then, the NHSPA assessment has been administered until 2012-2013. All NHSPAs essentially employed two sampling methods: (1) stratified random samples of health facilities providing BPHS in provinces of Afghanistan, and (2) systematic random samples of patients and health workers [101]. There are different levels of facilities in the country – health posts, sub-centers, basic health centers, comprehensive health centers and district hospitals. Due to the variation of the facilities, in size, staffing levels and population served, the sampling was stratified by level of facility.

This stratified sample generally includes a sample of up to 25 facilities per province each year - 15 Basic Health Centers, 7 Comprehensive Health Centers and 3 District outpatient departments. In provinces where there were fewer than 25 active BPHS facilities, all active facilities were sampled and surveyed. Within each sampled facility, the NHSPA included a random sample of health workers, and a systematic sampling of patients, depending on the estimated number of new outpatients expected on the day of assessment [75]. Trained surveyors then conducted interviews with sampled health workers, made direct observations of clinical interaction between patients and providers, and conducted exit-interviews with sampled patients.

UNIT	2004	2005	2006	2007	2008	2009-10	2011-12	2012-13
Number of Provinces	33	30	30	30	29	34	33	34
Number of Facilities	617	629	630	636	618	726	738	725
Number of Observations of Patient-Provider Interactions	5719	5856	5964	6089	5970	7979	6826	6930
Number of Exit Interviews	5597	5862	5964	6087	5950	7979	6826	6930
Number of Health Workers Interviewed	1553	1452	1723	1940	2233	2281	2393	2403

Table 4.1 Samples from National Health Service Performance Assessment from 2004 to 2013[102]

The sampling of facilities in each province was carried out independently from one year to another. Therefore, the same facilities were not included in each year's sample.

Furthermore, in certain years, insecure conditions did not allow all provinces to be studied in the NHSPA. Provinces, of which 34 are currently recognized, are generally regarded as primary administrative divisions. For instance, in 2004, the first year of NHSPA, Daykundi province had just been formed, and health facilities were being constructed; therefore the province was excluded from the NHSPA in 2004. In most years, up to five provinces were excluded each year, primarily due to security reasons. There were only two years when all provinces were included in the sample: 2010-2011 and 2012-2013. Consequently, only 29 provinces have been consistently sampled over the years. Table (4.1) describes the different NHSPA samples for each year, while Table (4.2) depicts the provinces excluded from NHSPA for each year, and reasons for exclusion.

Year	Number of excluded provinces	Name of excluded provinces	Reason for exclusion
2004	1	Daykundi	Newly formed province, BPHS facilities still underway
2005	4	Kandahar, Helmand, Zabul, Uruzgan	Security reasons
2006	4	Kandahar, Helmand, Zabul, Uruzgan	Security reasons
2007	4	Kandahar, Helmand, Zabul, Uruzgan	Security reasons
2008	5	Kandahar, Helmand, Zabul, Uruzgan, Farah	Security reasons
2009-2010	0	-	-
2010-2011	-	-	Data collection timeframe changed
2011-2012	1	Nuristan	Security reasons
2012-2013	0	-	-

*Table 4.2 Excluded Provinces in National Health Services Performance Assessments over the years between 2004 and 2013**

*Constructed from annual national reports of Balanced Score Card for BPHS in Afghanistan.

The NHSPA is designed to collect data for indicators that fall under six health-services-related domains, although the domains have been adapted over the years since the conception of NHSPA [101]. The following table shows the most recent revision of the domains and their respective indicators.

Domain A: Client and Community (2 Indicators)
1. Overall Client Satisfaction and Perceived Quality of Care Index
2. Community Involvement in Decision-making
Domain B: Human Resources (6 Indicators)
3. Health Worker Satisfaction
4. Health Worker Motivation
5. Salary Payment Current
6. Minimum Staffing Index
7. Provider Knowledge Score
8. Staff received training
Domain C: Physical Capacity (5 Indicators)
9. Equipment Functionality Index
10. Pharmaceuticals and Vaccines Availability Index
11. Laboratory Functionality Index
12. Clinical Guidelines Index
13. Infrastructure Index
Domain D: Quality of Service Provision (4 Indicators)
14. Client Background and Physical Assessment Index
15. Client Counseling Index
16. Universal Precautions
17. Time Spent with Client
Domain E: Management Systems (3 Indicators)
18. Revised HMIS Use Index
19. Financial Systems
20. Health Facility Management Functionality Index
Domain F: Overall Mission (2 Indicators)
21. Outpatient Visit Concentration Index
22. Client Satisfaction Concentration Index

Table 4.3 Domains and their respective indictors of NHSPA in 2012-2013

Sampled health facilities, health workers and patients were surveyed via pre-defined and pre-tested tools. The survey tools consist of 8 forms. Table (4.4) illustrates the name of the forms, and the intended usage of each form.

Name of form	Details
F1/F3	Patient Observation/ Exit Interview (for patients under 5 years of age)
F2/F4	Patient Observation/ Exit Interview (for patients >=5 years of age)
F5	Health Worker Interview
F6	Community Health Worker (CHW) assessment
F7	Facility Assessment (Basic Health Centers/Comprehensive Health Centers/Subcenters)
F8	Facility Assessment (Health Posts)

Table 4.4 Brief descriptions of Forms used in National Health Services Performance Assessments

SA (1) utilizes Form 7 Data from the years 2004 to 2012-2013.

SA (2) draws on the data collected in 2011-2012, especially F1/F3 and F7.

Ethical Consideration

All the analyses in this dissertation were done on previously collected datasets, i.e. all analyses were secondary data analyses. These datasets came from primary data collected by the JHSPH team in Afghanistan, in collaboration with the Ministry of Public Health of Afghanistan.

The Institutional Review Boards (IRB) of Johns Hopkins Bloomberg School of Public Health, and the Ministry of Public Health of Afghanistan, approved the primary data collection through formal procedures. The NHSPA was considered public health practice and not human subjects research. No NHSPA datasets contained personal identifiers. The dissertation project drew entirely on NHSPA datasets; the dissertation project did not involve animals, human subjects, or individually identifiable data from or about humans. See Annex for completed and approved Thesis Research Documentation Form.

5. Chapter (5): Is improving structural quality of maternity health services associated with increased institutional deliveries across provinces of Afghanistan?

Abstract

Background

This chapter assesses the association between structural quality of maternal health services and the utilization of the services as measured by institutional deliveries. The MoPH of Afghanistan inherited a devastated health system after the fall of the Taliban in 2001. The country then experienced some of the world's worst health indicators and the maternal mortality ratio, 1,600 per 100,000 live births, was the highest ever recorded. In 2003, Afghanistan and its partners created the Basic Package of Health Services to rebuild the health system and improve health of its people. One strategy that aimed to decrease maternal deaths was to promote facility deliveries. This paper aims to contribute to the nascent knowledge on the association between quality improvement efforts of maternal services and institutional deliveries in Afghanistan by quantifying the longitudinal relationship between the two variables over the course of 10 years.

Methods

Longitudinal data analysis methods were used on 3,691 observations made at 1,354 unique facilities in 34 provinces of Afghanistan between 2004 and 2013. On a stratified random sample of subcenters, BHCs, CHCs and District Hospitals which were surveyed over 8 rounds of data collection over the period of 10 years, Poisson regression models were used to assess the association between structural quality of maternal services, as measured by a composite score, and utilization of services, as measured by counts of institutional deliveries within various time frames, controlling for types of facilities, managing agencies, total number of staff at the facilities and total volume of services provided at the facilities. The effect of

structural quality on deliveries was separated into cross-sectional and longitudinal effects. Random intercepts were included to account for within-facility correlation over time and the Robust Variance Estimator was used to make the models more resistant to violation of assumptions such as over-dispersion.

Results

The findings provide strong evidence that structural quality improvement of maternal health services was positively associated with facility deliveries. For every 10% increase in a scale of maternal structural quality, there was a 9% increase in the rate of institutional deliveries ($P<0.001$). The cross-sectional effect (between-facility effect at baseline) and longitudinal effect (within-facility effect over time) of structural quality on the rate of deliveries were 8% and 9% respectively, values which were not statistically different from each other ($P=0.42$). The facilities supported by NGOs were found to have 24% higher institutional delivery rates than did facilities without any support ($P<0.001$). The increase in the rates of institutional deliveries was also associated with higher-level facilities, more staff and higher total volume of non-delivery services at the facilities.

Conclusions

The study quantified the association between select demand-side facility-level characteristics and institutional delivery. Improving structural quality and NGO support appeared to play a role in promoting facility deliveries in Afghanistan. This finding should stimulate continued investment in, and partnerships for, strengthening maternal health services in Afghanistan. This finding could also contribute to the empirical evidence for policy makers and implementers in other countries who aim to realize maternal health gains, especially in a post-conflict setting.

Introduction

Afghanistan is one of the most fragile states in the world affected by externally and internally driven conflicts. As a result, the country was left with a moribund health system with very low population coverage. The public sector was by and large not accessible to most of the population. Decades of war and low investment in health created a wide gap of inequality in health. Poor infrastructure in transportation and lack of social safety nets compounded the challenge, especially in the rural areas where more than 70% of the population resides [34],

Some proposed that the health challenges of Afghanistan could be effectively captured by just three indicators[103] – first, a mere 10% of the population had access to a health facility which was within one hour of walking [104]. Second, infant and under-five mortality were the fourth highest globally in 2002, standing at 165 and 257 per 1,000 live births respectively. Third, a study in 2005 estimated the maternal mortality ratio to be 1,600 per 100,00 live births and it was the highest ever recorded [105].

The silver lining in the dire situation was that it piqued the interest of international partners to help improve the situation. This, when combined with the desire of Afghanistan's MOPH to prioritize the underprivileged population in rural areas, led to the consideration of a mechanism through which health services could be provided in such a way that it would have maximum benefits for the largest number of recipients[106]. The precedence of using a package of basic health services in other countries such as Bosnia, Herzegovina, Cambodia, Rwanda and Uganda helped pave the way for a similar mechanism in Afghanistan [107-110]. Adapted to the specific needs of Afghanistan, Basic Package of Health Services was conceived in 2002, with four mains concerns in mind – effectiveness, scaling up, equity and sustainability.

BPHS was composed of seven components: maternal and newborn health, child health and immunization, nutrition, control of communicable diseases, mental health, disability and provision of essential drugs. Explicitly defining each type of health facility in the primary care chain and the size of the catchment population, BPHS formed the core of the health services delivery. It also linked specific health services to each type of facilities [103].

To assess and improve the progress of BPHS implementation, National Health Service Performance Assessments were conducted almost every year between 2004 and 2013 totaling up to 8 rounds of data collection. NHSPA recorded ongoing progress in all six domains of performance: patient and community perspectives, staff perspectives, service provision, capacity for service provision, financial systems and overall vision [102].

In addition to NHSPA, other large-scale household surveys were also conducted over the years: Multiple Indicator Cluster Survey in 2003, National Risk and Vulnerability Assessment in 2005 and 2007, Afghanistan Health Survey in 2006 and 2012, and Afghanistan Mortality Survey in 2010[51, 52, 54, 55]. These national studies altogether revealed improvements in key maternal health indicators among other conditions and diseases. Antenatal care coverage had been gradually increasing since 2003 reaching up to 48.5% in 2012. Skilled birth attendance rates rose from under 10% in 2003 to 40.5% in 2012. Institutional deliveries also climbed to 32.4% in 2012 from under 5% in 2003 [111].

This chapter aims to assess the quantitative association between the improvements in the quality of maternal services and the increase in facility births. Although there were a number of preceding studies about determinants of quality of care and determinants of institutional delivery, little is known about the association between structural quality of frontline health facilities and institutional delivery rates, especially in the context of Afghanistan. This study intends to fill this gap.

Methodology

Sample

The analysis was based on 3691 observations made in 1354 unique facilities in all 34 provinces of Afghanistan between 2004 and 2013. Individual observations were made in a stratified random sample of subcenters, BHCs, CHCs and District Hospitals, surveyed over 8 rounds of data collection between 2004 and 2013.

Data source

The analysis utilized facility survey data (Form 7) of the National Health Services Performance Assessment collected yearly between 2004 and 2012, with the exception of 2010 where the timeframe of data collection was shifted. Altogether, the dataset consisted of 8 rounds of data collection. Each year, a stratified random sample of 25 facilities providing Basic Package of Health Services were sampled from each province. From 2004 to 2008, district hospitals were included in the BPHS samples, not subcenters. Starting in 2009-2010, subcenters were included in the BPHS samples and district hospitals were moved to Essential Package of Hospital Services. Therefore, each year 5 CHCs, 15 BHCs and 5 subcenters or 5 district hospitals were included, summing up to 25 facilities in each province. In provinces where there were fewer than 25 active BPHS facilities, all active facilities were sampled and surveyed. Within each sampled facility, the NHSPA includes a random sample of health workers and a systematic sampling of patients, depending on the estimated number of new outpatients expected on the day of assessment [75].

The number of provinces also varied over the years as some had not been formed yet or had been omitted due to security concerns.

The following table depicts the original sample across the years and the final working dataset.

	Original Dataset			Final Working Dataset		
Year	Provinces	Facilities	Total observations	Provinces	Facilities	Total observations
2004	30	551	551	27	171	171
2005	28	612	612	27	265	265
2006	28	612	612	28	417	417
2007	28	615	615	28	487	487
2008	28	600	600	28	474	474
2009 (2009-10)	34	761	761	31	485	485
2011 (2011-12)	33	780	780	33	675	675
2012 (2012-13)	34	776	776	34	717	717
Total			5307			3691

Table 5.1 Provinces and facilities in final working dataset in comparison with original dataset

As the facilities were sampled randomly each year, the same facilities were not consistently included in the survey over the years. Table (5.2) shows the characteristics of the final working dataset with the distribution of consistently sampled facilities across the years. There are altogether 1354 unique facilities sampled across the 8-year period. Most of facilities (33%) were sampled only once. 395 facilities (30%) were sampled 4 or more years. Only 7 facilities (1%) were consistently included in the sample for all 8 years. 30% of facilities were sampled 4 or more years.

Year count	Frequency	Percent
1	452	33%
2	308	23%
3	199	15%
4	155	11%
5	103	8%
6	75	6%
7	55	4%
8	7	1%

Table 5.2 Frequencies of the same facilities randomly sampled across 8 rounds of data collection

Operationalization of Variables

SA (1.1) Outcome of Interest: Institutional Deliveries

The outcome of interest was operationalized as the counts of institutional deliveries at health facilities over a time period. As the data collection tools differed between years, the length of the time period during which counts of deliveries were recorded also differed. Table (8.1) in the Appendix section illustrates how the data on institutional delivery was collected and the variability of the exposure time (t) in different years. In the year 2004, t ranges from 1 to 12 months, depending on availability of data. From the year 2005 to 2009, t was 1 month while in 2011 and 2012, t was 6 months. Based on this, average deliveries per month was calculated (counts divided by number of month t).

SA (1.1) Explanatory Variable: Structural Quality of Health Facilities

Structural Quality of Health Facilities was operationalized as a composite measure calculated from 12 items, 11 of which were mandatory items while 1 was dependent on whether the health facility was providing antenatal services or not. The items were tabulated in table (5.3). These binary items were converted into a percentile score, ranging from 0 to 1. To maximize the use of available data, missing items were not dropped listwise. Instead, the value of the denominators was modified according to missing data. For example, if 3 items showed missing data, the denominator was set at 12-3=9.

	Mandatory Items		**Skip-pattern-dependent items**
1	Availability of pregnancy test		If AN services provided
2	Availability of condoms	1	Availability of blood pressure cuff
3	Availability of oral contraceptives		
4	Availability of depot injection		
5	Availability of IUDs		
6	Availability of AN services		
7	Availability of clean delivery kits		
8	Availability of fetoscope		
9	Availability of suction equipment		
10	Presence of IMCI chart		
11	Presence of family planning guidelines		

Table 5.3 Items included in the calculation of the composite score on Structural Quality of Maternal Services

SA (1.1) Covariates

Types of facility were included in the model. They were stratified into district hospitals, comprehensive health centers, basic health centers and subcenters.

Another covariate was year. Indicator variables were created to represent 8 rounds of data collection between 2004 and 2012-2013.

A binary variable depicting whether facilities were supported by NGOs was included as one of the explanatory variables. Facilities were operated by MOPH without NGO support, MOPH with NGO support or operated by NGO only. However due to inconsistent availability of data granularity, facilities operated by MOPH with NGO support and facilities operated by NGO only were merged into a single category "NGO supported facilities."

A continuous variable of total staff was included as a covariate. It encompassed both clinical and support staff working at the facility during the previous month.

Monthly total volume of services was constructed as a continuous variable. It was created by combining total number of new patients and total number of re-attendance, excluding number of deliveries.

Analysis

Analysis Outline

Secondary Data Analysis was conducted entirely in STATA version 14 [112].

The extent and pattern of missingness were assessed. Univariate statistical methods were used to explore the variables. Descriptive statistics were used to provide a summary about the sample and the measures. Correlation of variables was explored, both graphically and mathematically. Multicollinearity between variables was assessed using Variance Inflation Factor (VIF).

Longitudinal data analysis methods were used to accommodate as well as to exploit the longitudinal nature of the dataset. Bivariate and multivariate Poisson Regression models were fitted to assess the association between structural quality of care and utilization of health services. In the regression analyses, robust variance estimator was used to make the model more resistant to violation of assumptions such as overdispersion in the data [113]. Random intercepts were included to account for non-independence in the number of deliveries within a facility over time [114].

Assessing Missingness

Missingness extent and patterns were assessed, both on outcome and explanatory variables. Table (5.4) depicts missing data on institutional deliveries and structural quality.

Year	# of unique Facilities	% (n) missing in deliveries over an exposure period (t)	% (n) missing in exposure period (t)	% (n) missing in monthly average of deliveries (deliveries/t)	% (n) missing in structural quality
2004	551	59.35 % (327)	65.88 % (363)	65.88 % (363)	0
2005	612	50.65 % (310)	50.65 % (310)	50.65 % (310)	0
2006	612	30.56 % (187)	30.56 % (187)	30.56 % (187)	0
2007	615	19.51 % (120)	19.51 % (120)	19.51 % (120)	0
2008	600	19 % (114)	19 % (114)	19 % (114)	0
2009	761	33.25% (253)	33.25% (253)	33.25% (253)	0
2011	780	10% (78)	10% (78)	10% (78)	0
2012	776	5.93% (46)	5.93% (46)	5.93% (46)	0
All years	5307 data points	8.50% (451)	27.72% (1471)	27.72% (1471)	0

Table 5.4 Missing information on items used in the calculation of institutional deliveries and Missing in Structural Quality

There were 5307 data points in the long format dataset. Missing on institutional deliveries (either on number of deliveries or exposure (t) or both) accounted for 1471 data points (27.7 %).

	Non-missing on Deliveries n (%)/median(IQR)	Missing on Deliveries n (%)/median(IQR)
Facility Type		
BHC	1939 (52%)	1023 (69%)
CHC	1226 (33%)	304 (21%)
Subcenter	364 (10%)	106 (7%)
District Hospital OPD	179 (5%)	38 (3%)
Managing Agency		
MOPH without support	336 (9%)	250 (18%)
NGO supported/ NGO only	3492 (91%)	1103 (82%)
Total Number of Staff	13 (6, 32)	8 (5, 19)
Volume of Service	1446 (921, 2249)	908 (591, 1351)

Table 5.5 Missing pattern of Institutional Deliveries across certain Facility-level Characteristics

Table (5.5), illustrates the pattern of missing according to certain characteristics of the facilities. The percentages shown were column percentages.

Then the missingness of covariates were assessed. The following table compares the missingness of covariates before and after dropping those data points missing on Y (institutional deliveries).

Covariates	Missing before dropping missing on Y (n=5307)	Missing after dropping missing on Y (n=3836)
Structural Quality (main exposure variable)	0	0
Facility Type	0	0
Managing Agency	126 (2.37%)	8 (0.21%)
Total Number of Staff	1 (0.02%)	1 (0.03%)
Volume of Service	474 (8.93%)	136 (3.55%)
Missing in at least one of the above	571 (10.76%)	144 (3.55%)

Table 5.6 Missing extent in Covariates before and after dropping observations with missing on institutional deliveries

Listwise deletion for incompleteness of the response variable and the explanatory variables was done for 1615 observations. One observation with an impractically large response variable was also dropped from the analysis. A total of 3691 observations was retained for the analysis.

Exploration of the variables

Table (5.7) shows summary of monthly institutional deliveries across the years by facility type.

		2004	2005	2006	2007	2008	2009	2011	2012	All 8 years
Subcenter	Median	0	0	0	0	0	2	1	1	2
	Mean	0	0	0	0	0	3	3	2	3
	Std. Dev.	0	0	0	0	0	3	7	3	5
	Min	0	0	0	0	0	0	0	0	0
	Max	0	0	0	0	0	16	50	17	50
	# of obs:	0	0	0	0	0	73	124	150	347
BHC	Median	4	1	1	3	4	5	3	4	3
	Mean	14	2	2	4	6	7	5	6	5
	Std. Dev.	24	4	3	4	5	17	7	9	10
	Min	0	0	0	0	0	0	0	0	0
	Max	114	30	20	22	30	264	75	111	264
	# of obs:	73	112	222	257	263	241	351	344	1863
CHC	Median	3	3	6	10	12	16	16	20	10
	Mean	9	5	9	12	17	21	21	26	16
	Std. Dev.	21	6	10	12	15	17	20	31	20
	Min	0	0	0	0	0	0	0	0	0
	Max	171	44	54	78	79	79	98	323	323
	# of obs:	80	123	155	185	171	139	158	173	1184
District Hospital	Median	17	27	56	66	56	62	94	89	60
	Mean	48	43	80	78	87	82	116	123	88
	Std. Dev.	83	52	82	64	75	60	93	108	84
	Min	0	2	0	10	6	5	18	3	0
	Max	300	239	431	323	303	219	443	582	582
	# of obs:	18	30	40	45	40	32	42	50	297
All Facility Types	Median	4	2	3	5	7	6	5	5	5
	Mean	15	8	12	14	17	15	16	18	15
	Std. Dev.	35	22	34	30	32	29	37	44	35
	Min	0	0	0	0	0	0	0	0	0
	Max	300	239	431	323	303	264	443	582	582
	# of obs:	171	265	417	487	474	485	675	717	3691

Table 5.7 Summary of Facility-level Monthly Institutional Deliveries across the years by facility type

The distribution of institutional deliveries per facility per month over the years was assessed using line graphs. Figure (5.1) shows mean (left) and median (right) institutional deliveries per month.

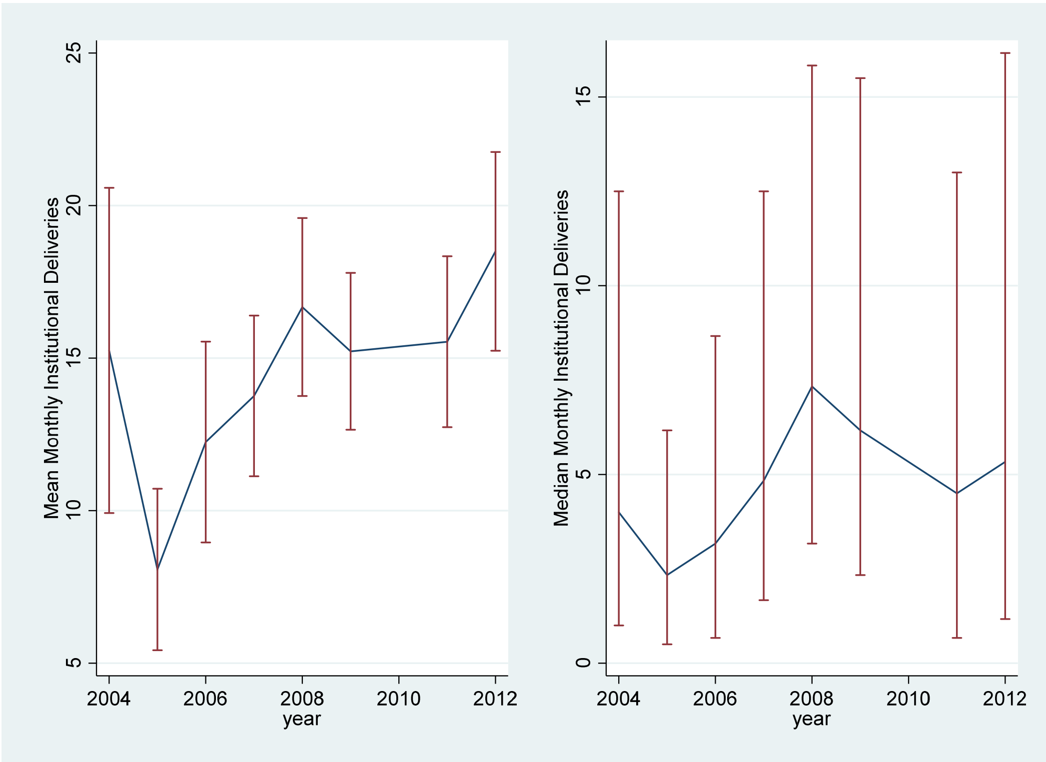


Figure 5.1 Facility-level Monthly Institutional Deliveries across the years (Left: Mean with 95% CI, Right: Median with IQR)

The distribution of deliveries per month was also assessed, which proved to be skewed to the right. After natural log transformation, the skewness was found to be reduced. Figure 5.1 depicts the distribution of monthly institutional deliveries before and after the natural log transformation. Log values for facilities with 0 counts of deliveries were set at =-2.6 as the lowest logavgdeli1 is -2.48.

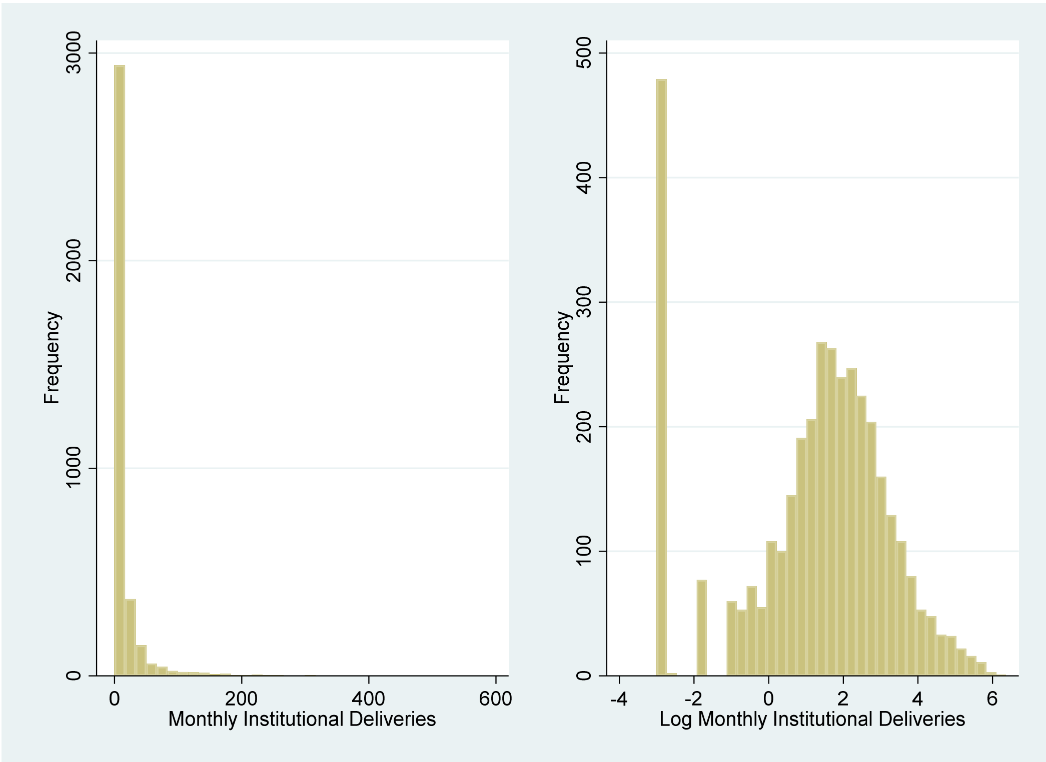


Figure 5.2 Distribution of Facility-Level Monthly Institutional Deliveries Before and After natural Log Transformation

Table (5.8) summarizes structural quality of health facilities over the years while figure (5.3) depicts the graphical representation of the summary.

		2004	2005	2006	2007	2008	2009	2011	2012	All 8 years
Subcenter	Median	NA	NA	NA	NA	NA	0.82	0.82	0.81	0.82
	Mean	NA	NA	NA	NA	NA	0.79	0.78	0.8	0.79
	Std. Dev.	NA	NA	NA	NA	NA	0.11	0.22	0.2	0.19
	Min	NA	NA	NA	NA	NA	0.45	0	0	0
	Max	NA	NA	NA	NA	NA	1	1	1	1
	# of obs:	NA	NA	NA	NA	NA	73	124	150	347
BHC	Median	0.6	0.67	0.75	0.83	0.92	0.91	0.91	0.92	0.83
	Mean	0.61	0.66	0.74	0.81	0.88	0.87	0.84	0.88	0.82
	Std. Dev.	0.23	0.18	0.14	0.12	0.09	0.1	0.2	0.16	0.17
	Min	0	0.17	0.17	0.42	0.55	0.25	0	0	0
	Max	1	1	1	1	1	1	1	1	1
	# of obs:	73	112	222	257	263	241	351	344	1863
CHC	Median	0.67	0.75	0.83	0.92	1	1	1	1	0.92
	Mean	0.64	0.75	0.81	0.89	0.94	0.94	0.94	0.93	0.87
	Std. Dev.	0.19	0.15	0.14	0.11	0.07	0.08	0.1	0.11	0.15
	Min	0.09	0.33	0.25	0.5	0.64	0.58	0.42	0.33	0.09
	Max	1	1	1	1	1	1	1	1	1
	# of obs:	80	123	155	185	171	139	158	173	1184
District Hospital	Median	0.58	0.83	0.92	1	1	0.82	0.89	0.89	0.92
	Mean	0.61	0.84	0.88	0.93	0.95	0.81	0.88	0.9	0.87
	Std. Dev.	0.2	0.13	0.13	0.1	0.07	0.16	0.11	0.1	0.14
	Min	0.27	0.5	0.5	0.5	0.75	0.27	0.67	0.67	0.27
	Max	0.92	1	1	1	1	1	1	1	1
	# of obs:	18	30	40	45	40	32	42	50	297
All Facility Types	Median	0.64	0.75	0.83	0.83	0.92	0.91	0.92	0.92	0.91
	Mean	0.63	0.72	0.78	0.85	0.91	0.88	0.85	0.88	0.84
	Std. Dev.	0.21	0.17	0.15	0.12	0.09	0.11	0.19	0.16	0.17
	Min	0.00	0.17	0.17	0.42	0.55	0.25	0.00	0.00	0
	Max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	# of obs:	171	265	417	487	474	485	675	717	3691

Table 5.8 Summary of Facility-level Structural Quality across Years by facility type

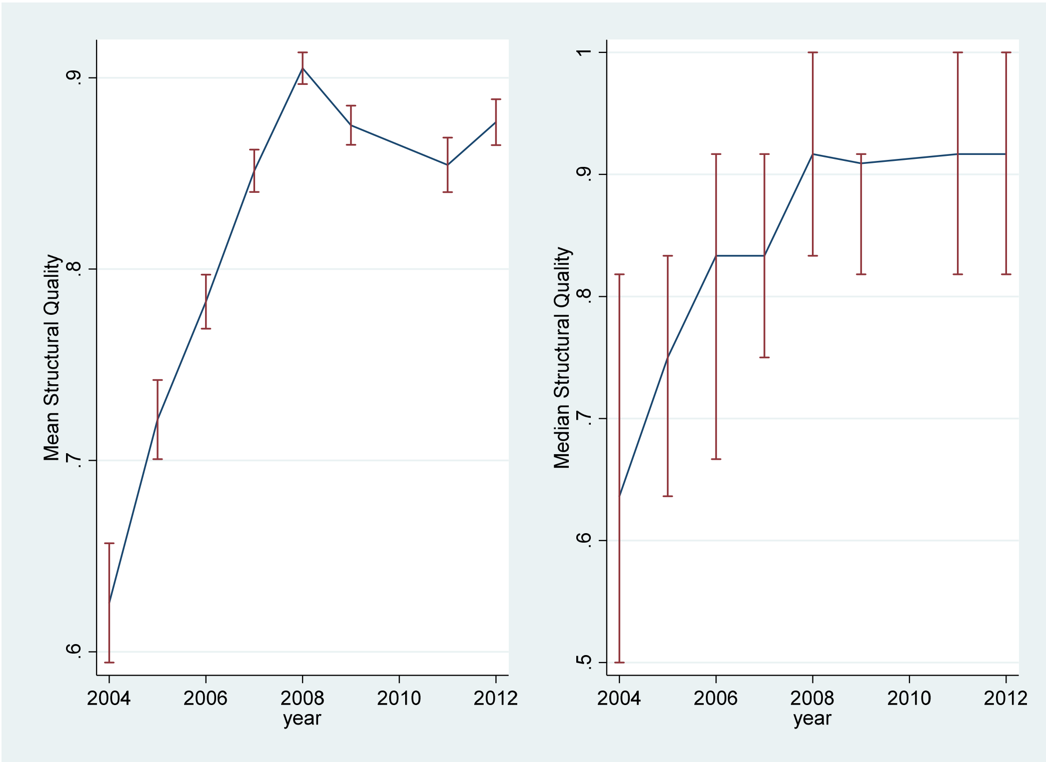


Figure 5.3 Facility-level Maternal Structural Quality across Years (Left: Mean with 95% CI, Right: Median with IQR)

Both the graph and table showed that structural quality seemed to have improved over the years. The year 2004 demonstrated the largest variation. It could be either due to comparatively smaller sample in 2004 (shown in table (5.1)) or the variability in the baseline attributable to wider gaps in quality between well-performing and poor-functioning facilities before quality improvement efforts.

Table (5.9) summarizes the description of the facilities involved in the survey. The average monthly facility deliveries across all years stood at 15.05 with a relatively large variation (SD = 34.96). The mean of structural quality of maternal services was 0.84 (min=0, max=1) with a standard deviation of 0.17.

In terms of managing agencies, only 9 percent of facilities (n=316) were managed directly by MOPH of Afghanistan without any support from international partners. The rest, 91% (n=3375), were either supported or managed by NGOs. The mean total number of staff, including both clinical and supporting, was 22.34 (SD=25.10). The total number of services provided at each facility per month, as measured by combined total of new and follow-up patients seen, showed a wide range from 0 to 125,600 with a mean of 1884 and standard deviation of 2623.

Variables	Average*/ Count	SD*/ %
		n=3691
Monthly deliveries	15.06*	34.96*
Structural quality	0.84*	0.17*
Facility type		
Subcenters	347	9%
BHCs	1863	51%
CHCs	1183	32%
District Hospitals	297	8%
Managing Agency		
MOPH without support	316	9%
NGO support	3375	91%
Total no. of Staff	22.34*	25.10*
Monthly volume of service*	1884*	2623*

Table 5.9 Summary Characteristics of Variables

Figure (5.4) depicts the response variable, average institutional deliveries per facility, and the main predictor variable, structural quality of maternal services. In general, both variables showed considerable variation and seemed to be increasing across the years, especially the structural quality. It was also noted here that the year 2004 showed larger variability in both parameters. Again, there were two possible explanations for this. First, it could be due to relatively smaller samples. Second, it could be due to variability at baseline before the effect of implementation.

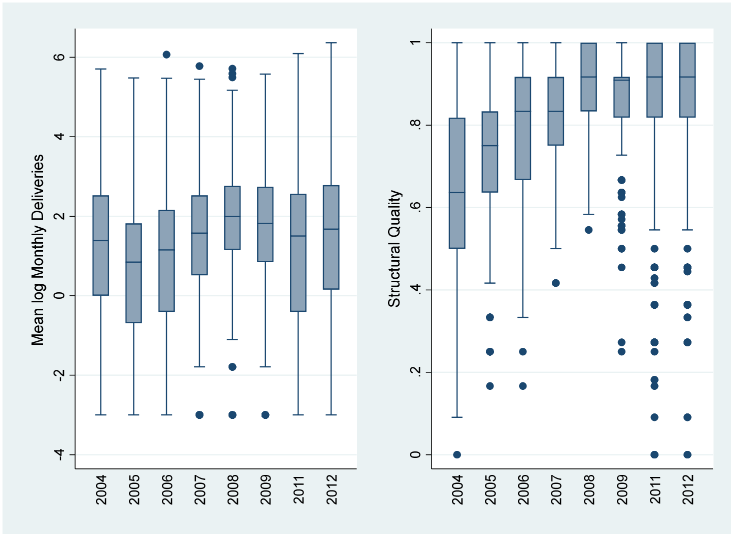


Figure 5.4 Box Plots of Mean Monthly Log Institutional Deliveries (left) and Structural Quality (right) at Facilities across Years

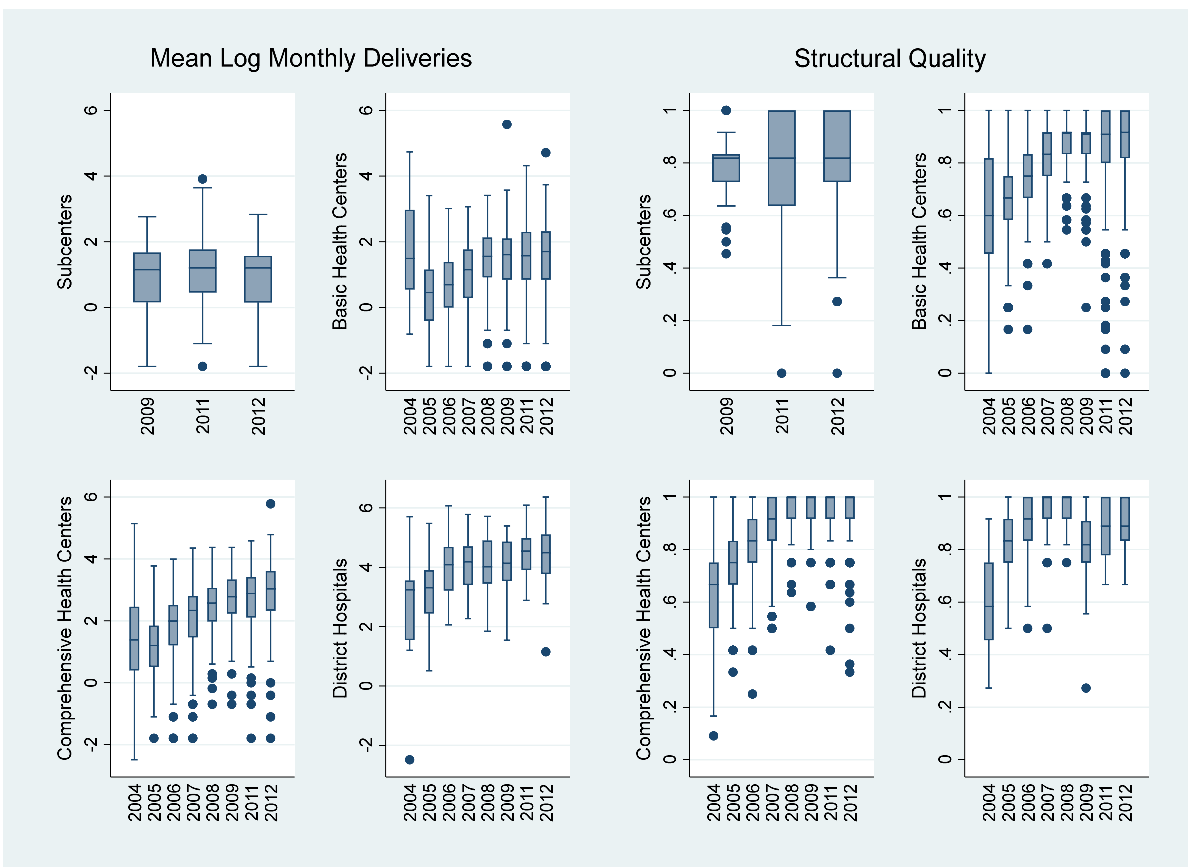


Figure 5.5 Box Plots of Mean Monthly Log Institutional Deliveries and Structural Quality at Facilities across Years by Facility Type

The trend of structural quality and monthly institutional deliveries at the facility level across the years were explored using 'spaghetti' plots. When all the 3691 observations were included, the graph were too busy to be decipherable. Instead facilities which were randomly sampled in more than 4 rounds of data collection were used, the result of which were depicted in the following graphs.

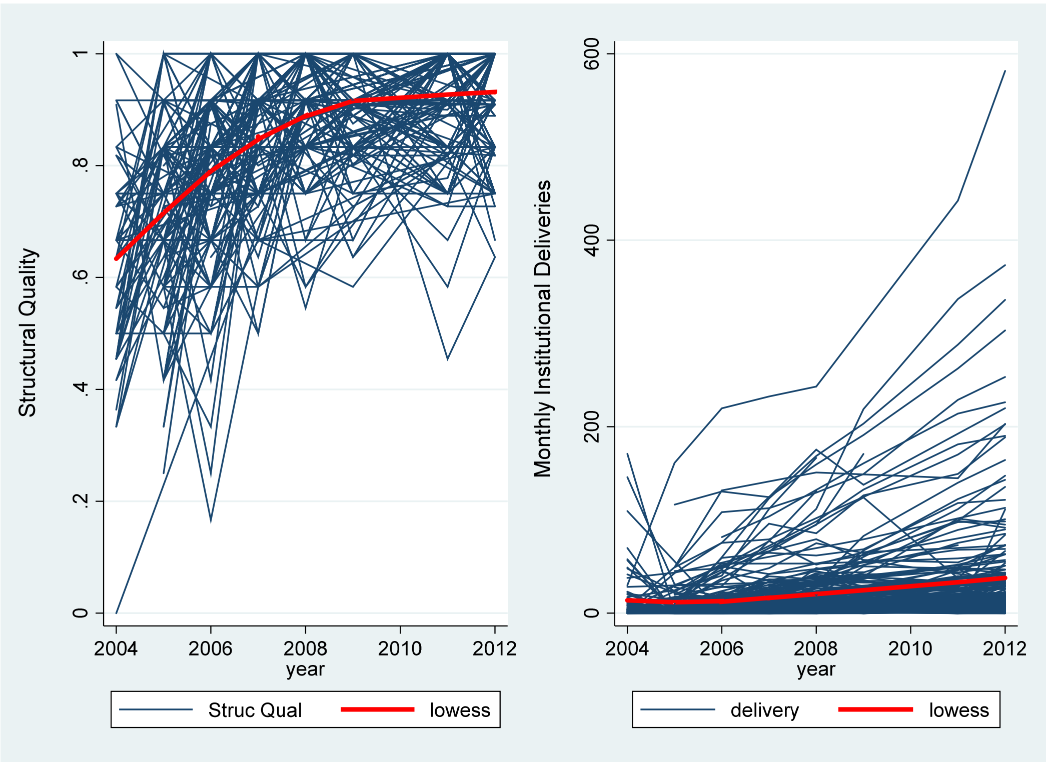


Figure 5.6 Lowess smoothing of Structural Quality and Monthly Institutional Deliveries by year (for facilities randomly sampled in more than 4 rounds of data collection)

<u>Exploration of correlation</u>

It was known that the response variable was often correlated within subjects even after controlling for covariates [114]. To assess this, a within-subject correlation matrix of the estimated residuals was obtained graphically as well as numerically.

A single factor ANOVA was fitted, using "year" as the factor. The residuals from the model were explored to see how correlation between observations changed with time. The following is the graphical and numerical representation of the resultant residuals.

The graph below illustrated correlation between repeated observations at facilities across the years. Correlations were strongest between adjacent years and decreased as the time lag increased. An apparent exception was seen in observations from the year 2004, which were of lowest correlation regardless of the time lag. It was also observed that as the time interval between occasions increased, the correlation between the corresponding residuals generally tended to decline. In other words, the correlation 'decayed' with time. This type of correlation is often referred to as longitudinal correlations or serial correlations or within-subject correlations or autocorrelation [114].

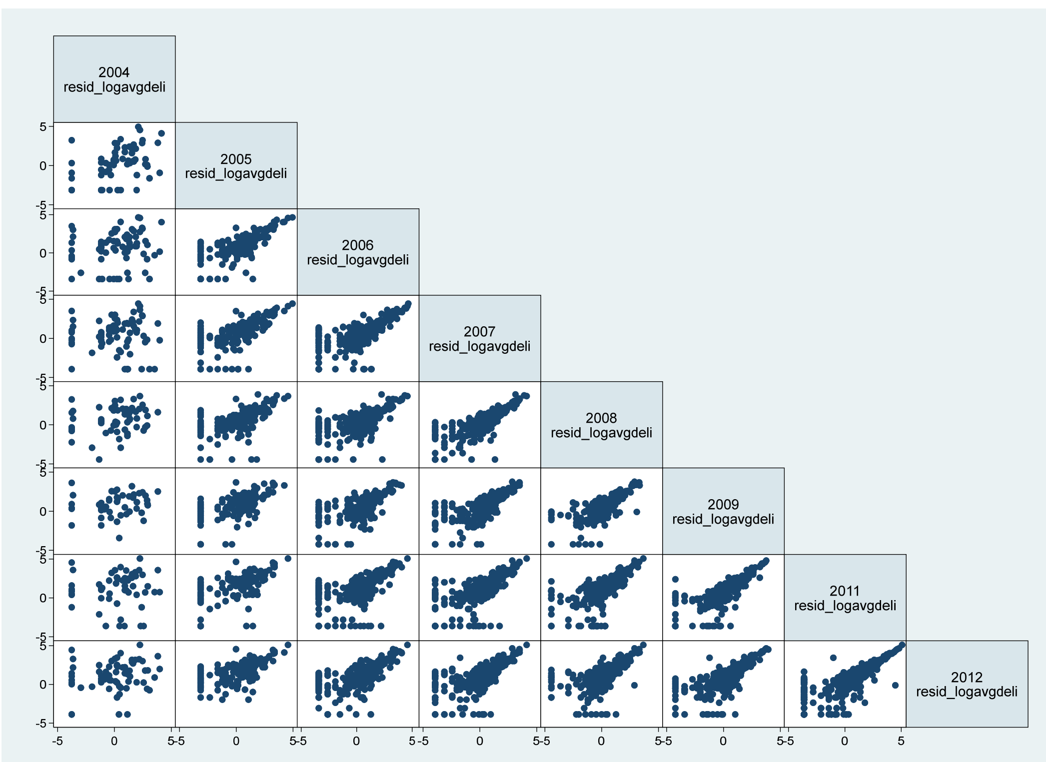


Figure 5.7 Scatterplot matrix of residuals from a single factor ANOVA analysis using only "Year" as the factor

	res~2004	res~2005	res~2006	res~2007	res~2008	res~2009	res~2011	res~2012
resid_l~2004	1.0000							
resid_l~2005	-0.2971	1.0000						
resid_l~2006	-0.3422	0.8109	1.0000					
resid_l~2007	-0.3745	0.7091	0.9402	1.0000				
resid_l~2008	-0.3462	0.7566	0.7593	0.8856	1.0000			
resid_l~2009	-0.4381	0.7921	0.8158	0.9091	0.9725	1.0000		
resid_l~2011	-0.5479	0.7740	0.8462	0.9258	0.9557	0.9689	1.0000	
resid_l~2012	-0.4259	0.7421	0.8302	0.9396	0.9783	0.9906	0.9799	1.0000

Table 5.10 Correlation matrix of the residuals from a single factor ANOVA analysis using only "Year" as the factor

The numerical matrix of correlation was calculated empirically. It reflected the findings in the graphical matrix. Both the graph and the tables pointed that there seemed to be some degree of correlation within the facilities. Negative correlation appeared to be an artifact arising from assigning an arbitrarily small value of -2.6 for log average deliveries for the facilities with zero deliveries (facilities with true zeros).

Autocorrelation was also explored graphically using a user-defined ado file. The autocorrelation function is considered most effective for studying equally-spaced data that are roughly stationary [115]. Graph (5.8) showed that there was autocorrelation even at large lags, i.e. the observations were correlated up to 5 years apart. However, the correlation quickly decayed after lag 5 year.

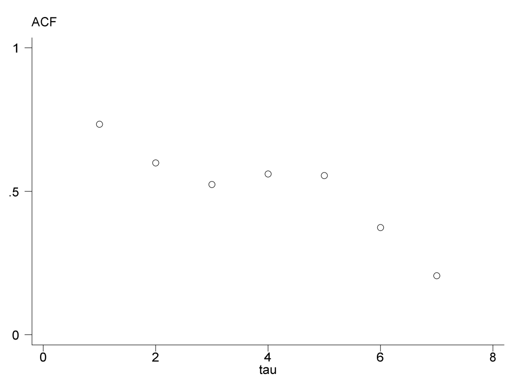


Figure 5.8 Assessment of Autocorrelation of the Residuals using Autocorr Function

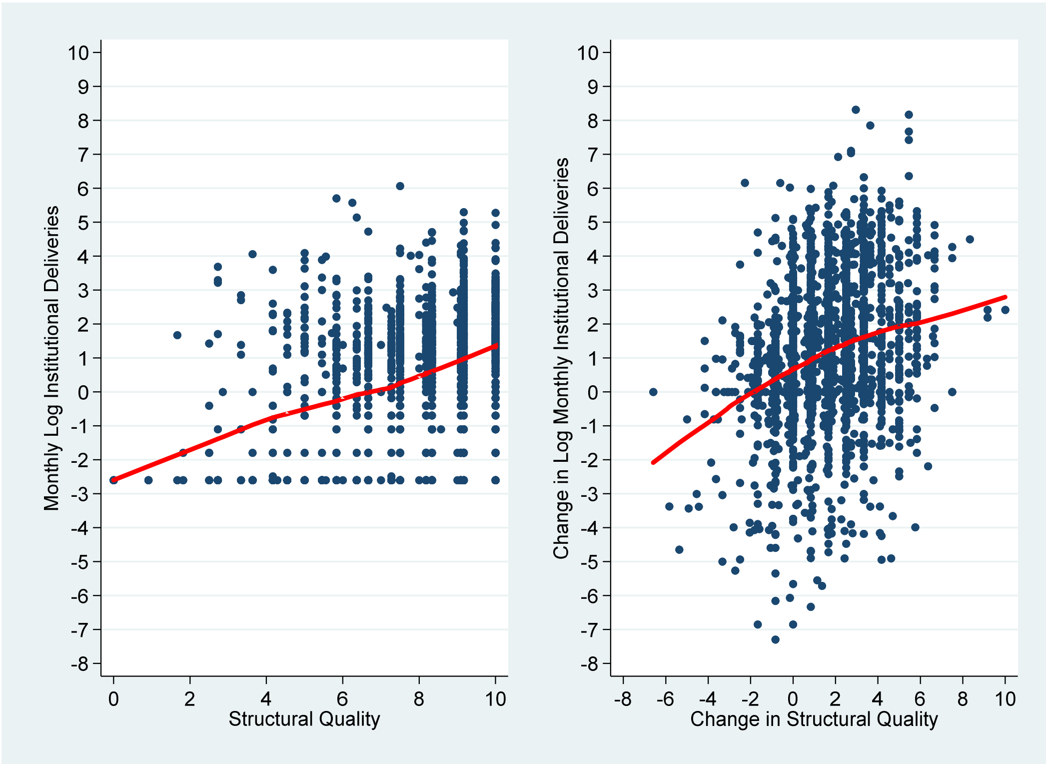


Figure 5.9 Cross-sectional (left) and Longitudinal (right) Association between Monthly Log Institutional Deliveries and Strcutural Quality of Facilties

Separation of Cross-sectional and longitudinal association was done mainly to study two things (1) to understand the mean outcome at the first observation as a function of quality (cross-sectional effect at baseline), and (2) to explore how the mean outcome changes as we moved forward from the first year (longitudinal effect). This is considered important since the main explanatory variable, structural quality, was a time-varying one, i.e. an exposure that changed with time.

The left graph represented the cross-sectional association between observations and the right, longitudinal. The left graph showed the differences between facilities in the baseline year of 2004. The right graph represented the changes across time within a facility. Both the cross-sectional and longitudinal exploration pointed to an apparent linear association between the outcome and exposure variable, i.e. institutional delivery changed with structural quality in the same direction.

Findings

	IRR	P>z	[95%	CI]
Structural quality-10% difference at Baseline	1.00	0.957	0.97	1.03
Structural quality-10% longitudinal increase	1.23	0.000	1.20	1.25
Year (Ref: 2004)				
2005	0.68	0.161	0.40	1.17
2006	1.28	0.284	0.81	2.03
2007	1.59	0.040	1.02	2.48
2008	2.22	0.000	1.49	3.29
2009	2.47	0.000	1.72	3.55
2011	3.07	0.000	2.04	4.61
2012	3.55	0.000	2.34	5.38
Facility type (Ref: BHC)				
CHC	2.59	0.000	2.30	2.92
Subcenter	0.28	0.000	0.22	0.35
District hospital OPD	14.20	0.000	12.49	16.15
Managing Agency (Ref: MOPH without support)				
NGO support	1.45	0.000	1.24	1.68
Total no. of Staff (10 increase)	0.99	0.212	0.96	1.01
Volume of service (1000 increase)	1.05	0.000	1.03	1.06

Table 5.11 Bivariate Analysis of Poisson Regression with Robust Variance

Table (5.11) describes the results from bivariate analysis. It showed that the response variable, institutional deliveries, was associated with structural quality, year (not all but some), facility types, managing agencies of the facilities and the volume of services provided at the facility.

The exponentiated regression coefficients can be interpreted as rate ratios or ratios of expected counts for the length of the interval observed (Note: the length of the interval observed varied between facilities and between years). The effect of structural quality was separated into a cross-sectional effect at baseline (between-facility) and a longitudinal effect (within-facility). At baseline, there was no association between structural quality and institutional deliveries, i.e. at baseline facilities with different structural quality scores did not see any statistical difference in facility births. However, the longitudinal effect of structural quality on institutional deliveries was found to be significant. There was a 23% increase in the rate of institutional deliveries within a facility for every 10 percent increase in structural quality, without adjusting for other characteristics of the facility. In other words, if the structural quality of a facility increased by 10% compared to the previous year, it was expected to see a 23% increase in institutional deliveries.

Year appeared to have an effect too. Qualitatively, the rate of institutional delivery had gradually increased, with the exception of the year 2005 and 2006. Quantitatively, the change in the rates of delivery was not significant until 2007 at the alpha level of 0.005. Type of facility was also found to be a significant factor. The level of the facility was positively associated with the rates of facility births. A positive association was also found between the response variable and volume of services. NGO support was found to be positively and significantly associated with facility birth rates. There was a 45% difference in the rates of deliveries between facilities with and without NGO support.

An unexpected finding was that there was a negative association between the response variable and total number of staff. However, the effect size was small, i.e. 1% decrease in the rates of institutional delivery for every 10 increase in total number of staff. Also, the association was not statistically significant at the alpha level of 0.05. (It was found later in the multivariate analysis that the direction of the effect was reversed and the effect became significant after controlling for other potential confounders.)

Table (5.12) tabulated results from multivariate analysis.

	IRR	P>z	[95%	CI]
Structural quality-10% difference at Baseline	1.08	<0.001	1.03	1.12
Structural quality- 10% longitudinal increase	1.09	<0.001	1.05	1.13
Year (Ref: 2004)				
2005	0.87	0.569	0.54	1.40
2006	1.30	0.214	0.86	1.97
2007	1.62	0.022	1.07	2.44
2008	2.16	<0.001	1.51	3.08
2009	2.71	<0.001	1.85	3.95
2011	3.45	<0.001	2.36	5.05
2012	3.85	<0.001	2.66	5.59
Facility type (Ref: BHC)				
CHC	1.80	<0.001	1.63	1.99
Subcenter	0.19	<0.001	0.14	0.26
District hospital OPD	8.37	<0.001	7.41	9.45
Managing Agency (Ref: MOPH without support)				
NGO support	1.24	<0.001	1.10	1.39
Total no. of Staff (10 increase)	1.05	<0.001	1.04	1.07
Volume of service (1000 increase)	1.04	<0.001	1.02	1.05

Table 5.12 Multivariate Analysis of Poisson Regression with Robust variance (Full Model)

The multivariate analysis illustrated the baseline effect of structural quality which was not significant in the bivariate analysis became so here. In the baseline year, a facility with a 10% higher structural quality score was expected to see an 8% increase in the rates of institutional delivery. This can be interpreted as a between-facility effect at baseline or a cross-sectional effect. A very similar effect size was found in the longitudinal effect. The results indicated that, given that the year, types of facility, managing agencies, number of staff and volume of services were the same, a facility was expected to see a 9 percent increase in the rates of institutional delivery for every 10 percent increase in structural quality. This can be interpreted as the longitudinal effect, meaning that as the structural quality of facilities increased over time, the increase in structural quality was significantly associated with increases in facility births, with other covariates remaining the same. The baseline effect and longitudinal effects were not found to be statistically different from each other (P=0.42)

For other covariates, there were no counter-intuitive findings, neither qualitatively nor quantitatively. As we moved on from 2004, a steady increase in the number of institutional deliveries was seen, except for the slight dip in 2005. (This was also captured in graph (5.1) in earlier exploratory data analyses.) However, the decrease was not statistically significant. It was also found that lower level of facility was associated with fewer deliveries. Subcenter recorded fewer deliveries than BHCs. CHCs and District Hospitals experienced higher number of deliveries. NGO-supported facilities seemed to have more institutional deliveries. There was also a positive association between facility deliveries and total number of staff posted at the facility. Facilities with higher volumes of total services had higher delivery rates.

Discussion

The study explored objectively measured structural quality of maternal services and other facility-level supply-side characteristics as predictors of institutional delivery rates in facilities in Afghanistan from 2004 to 2012.

The results showed that institutional delivery rates were associated with changes in the structural quality of maternal services of the facility after controlling for certain facility-level characteristics, viz types of facility, managing agencies of the facility, the total number of staff employed at the facility and total volume of services.

Both the cross-sectional effect (baseline effect) and longitudinal effect were significant. They were found to be qualitatively similar and not statistically different from each other in a formal test. In other words, the finding suggested that the between-facility and within-facility effects were similar and there was no sign of contextual effect.

In the multivariate model, one of the covariates which were statistically significantly associated with institutional delivery rates was type of facility. After adjusting for other characteristics, district hospitals were expected to see institutional delivery rates 7 times higher than the BHCs. The CHCs were expected to have more facility births than BHCs, while in turn the BHCs were expected to see more facility births than the subcenters. This finding was consistent with the expectation that the higher the level of the facility, the greater the number of facility births it will have. This situation may reflect that higher-level facilities have more capacity in terms of size, bed numbers, and human resources, and also that they absorb referrals from lower-level facilities. To ascertain which such characteristics of facilities bring about the effect cannot be explained within the scope of this study.

Another covariate with a statistically significant effect on the dependent variable was year. The effect size steadily increased with time, (with the exception of a slight decline in 2005), which implied that even if the structural quality of facilities remained the same, the institutional delivery rates would increase. While this study was unable to determine the cause of this phenomenon, a number of explanations are proposed below.

One possible explanation for this was an effect which is similar to what is termed as the period effect in longitudinal human studies. For studies involving humans, a period effect is defined to characterize a variable if, as it changes over time, the change uniformly affects all age groups and cohorts [116]. The period effect can be caused by factors external to facilities, which affect all facilities at a particular calendar time. The effect could be caused by a variety of social, environmental and economic factors. For example, more pregnant mothers might go to health facilities because they feel safer as security improved after the conflicts had de-intensified. Or roads had been built and transportation might become more favorable for commutes to the facilities as time went on. Or, as the intensity and frequency of conflicts had reduced, the economic condition for families was perhaps improving and increased household disposable income allowed access to health services that would not have otherwise been attainable.

The period effect can also be caused by methodological changes in outcome ascertainment. The information for the variable of institutional delivery was extracted from facility records. BPHS was implemented for the first time in 2003, and record keeping at facilities could have improved over subsequent years. Also, there were some years where data collection was delayed, and causing a shift in the time frame of data collection. The data collection for annual NHSPA rounds was typically completed by September each year, however, data collection was delayed in 2009, and it was decided to switch to year-round data collection (2009 November to 2010 September). One other methodological change was the move to community-based data collection. Community-based data collection was initiated by concerns about the lack of data in insecure provinces in the 2009-2010 round of data collection. Since then, local school teachers were trained and used as data collectors as well as supervisors, under the supervision of regular teams [102]. Although the new approach was tested for reliability, this could still have an effect on the outcome ascertainment. For example, health workers might respond differently to local teachers, or local people might spend more time to go through or to let health workers go through health facility records than was the case for surveyors of previous years.

Another possible explanation for the differentials between years was the aging effect. An aging effect is said to be present when the value of a variable changes as a function of age regardless of which cohort occupies a given age group in a particular time period [116]. In the current study, the aging effect could act on the implementation of BPHS itself or on the facilities. For example, as BPHS 'aged', more people might become more comfortable using the services provided at the facilities. Since the introduction of BPHS in 2003, more people might become aware of the programs. Or they might become more trustful of the health services or the services might become more popular among the community due to peer recommendations among those who have used the services over the years, and/or due to community advocacy by program implementers and community leaders. Similarly, the concept of an aging effect can be applied to facilities that were newly created in different provinces of Afghanistan. A deeper insight could have achieved if the data had been available on the time at which facilities began operating.

The third covariate which showed statistical association with institutional delivery was NGO support. NGO supported facilities were found to elicit higher utilization of delivery services at the facility than the facilities without NGO support. . However, it was unclear which were the particular characteristics of an NGO that were associated increased facility births.

The facilities can theoretically be divided into three broad categories, with regards to NGO support and management: (i) MOPH operated facilities without NGO support, (ii) MOPH operated with NGO support, and (iii) NGO only. However, in the present study, due to inconsistent availability of information across the years, categories (ii) and (iii) were merged into a single category; "with NGO support". Therefore, the analysis looked at only two categories – facilities with NGO support and those without.

The NGOs were different from each other in many aspects. Variation between NGOs might come from differences in inputs, processes and outputs. The differences might include, but were not limited to, contracting mechanisms, budget differentials, incentive structure for staff, job satisfaction and motivation of staff, access to technical support from external sources, autonomy of management, experience in Afghanistan, whether the NGOs were local or international, and the public outlook on the NGOs.

If community members believed that NGOs provide better quality services, they might opt for such facilities should they have the choice. It was known from previous studies that differentials in utilization could be to a certain extent explained by people's perception on quality of health services. Akin and Hutchinson reported that people sometimes bypassed the nearest facility and travelled further in order to receive, what they believed to be, better care [117].

At the same time, studies had found that NGO-supported facilities provided better quality than government-operated facilities [75, 118, 119]. A study in Afghanistan in 2008 reported that NGO-managed facilities were more likely than non-NGO facilities to have current salary payments, supervision and in-service training [75]. The same study reported that even after controlling for these factors, the association between NGO involvement and higher quality of care persisted. This finding hinted that there were other factors, either measured or unmeasured, affecting the association between NGO-managed facilities and quality. Although per-capita budget differentials were similar among NGOs, the study did not report information for total budget for facilities [75]. The answer to why, how, and which, characteristics of NGOs were responsible for the variation in institutional delivery rates warrants further investigation.

The other covariate that was explored in the present study, after controlling for other variables, was the total number of staff employed at the facility, which showed statistical association with the response variable. One limitation of the datasets was that they did not consistently provide enough granularity for all years to determine whether the "number of staff" referred to the expected number of staff as documented on paper, or the number of staff actually present. To acknowledge this uncertainty, for the present study, the working definition of number of staff was defined as the number working at the facility during the previous month.

The literature showed that absenteeism was not uncommon in health care delivery systems, especially in developing countries. . A study done across India, Indonesia, Peru and Uganda found that up to 35 percent of health care workers were absent from the health facilities to which they were assigned, and in some cases there were “ghost workers” who were on the books but never reported for duty [120]. Furthermore, the values reported for the number of staff should be considered carefully, especially for surveys in which data were collected was through a facility-survey respondent. Senior personnel in charge of a facility might not answer such questions truthfully, and may under-report unauthorized absence of workers at the facility [121].

Moreover, “missing-in-action” health workers are not uniformly distributed across different cadres of health workers and different types of facilities. A multi-country study reported that doctors are more likely to be absent than are other types of health workers [120]. This difference may be due to more marketable skillsets of doctors than that of other types of health workers. In Peru, for example, outside income from private practice was prevalent in 48 percent of doctors, but only in 30 percent of staff who were not doctors. Further information on this, and factors such as legal and social tolerance towards dual practice and types of contracts, would be necessary to explore this further.

Other factors associated with absent health workers included facility-level features such as frequencies of inspection by seniors, types and geographical location of health facilities (likelihood of absence being more pronounced at lower level and remote facilities), availability of potable water, provision of housing, vicinity to paved roads, and duties on nightshifts versus daytime [120]. To further explore the association between NGO support and facility births found in the present study, information on such variables would be needed.

The present study reported a positive association between institutional delivery rates and total volume of non-delivery services provided at the facility. The conceptual framework used shows that volume of services could impact utilization through more than one pathway, affecting both users and providers, and the direction of the effect could go either way. For example, volumes could affect waiting times for the patients, which in turn could affect perceived quality. Whether volume affects utilization positively or negatively depends on the context. If patients saw low volume as an indicator of poor quality, they would be hesitant to use the services provided at the facility. If high volumes made the waiting time longer, this may also cause patients to hesitate to use the facilities. On the provider side, health workers at high-volume facilities might feel stressed and over-burdened, which could then affect process quality.

Another reason volume was included in the analysis model was that the literature review suggested that there was an association between volume and quality of care. Systematic reviews and many individual studies indicated that volume was associated with quality [122-124]. Analyses in the present study also revealed that volume of services indeed confounded the association between the response variable and the main predictor variable of quality.

The present study provides a basis for understanding differentials in institutional deliveries among the facilities across provinces of Afghanistan between 2004 and 2013. The study demonstrated how the rates of institutional deliveries were associated with increase in structural quality and other 'determinants.' The findings may facilitate identification of means to increase institutional delivery, which is known (both conceptually and empirically) to be a pivotal strategy in reducing maternal deaths.

Prior studies have explored determinants of facility births and skilled attendance, both within and beyond Afghanistan. The present study explored the association between institutional delivery and supply side factors in the context of Afghanistan. The results suggested that supply side factors such as availability of items related to maternal services, viz pregnancy test, antenatal services, clean delivery kits, fetoscope, suction equipment and family planning guidelines, mattered in increasing facility delivery rates. This provides added evidence to implementers and policy makers to make sure that these resources are available in facilities.

The study found that the support of an NGO was a significant factor associated with institutional deliveries. The finding highlights the need for continued support and partnership. While aid agencies and humanitarian workers continue to support the county emerging from conflict, sustainability should be kept in mind. Exit strategies to optimize sustainability of effects and programs should be planned well in advance in conjunction with local advice.

Other demand side factors related to facility delivery have been demonstrated by other studies. One key barrier among many was disrespect and abuse in facility delivery. Examples include subtle humiliation of women, discrimination against certain sub-groups of women, overt humiliation, abandonment of care and physical and verbal abuse during childbirth [125]. There is a growing body of evidence that in certain contexts, disrespect and abuse are stronger deterrents than conventionally recognized barriers such as distance to facility and financial challenges [126, 127]. This evidence highlights that improvements in structural quality should be coupled with optimization of process quality.

Another important factor about which implementers should be aware is the gap between women's intended place of delivery and their actual place of delivery. A study found that only 71.1% of women who intended to deliver at the facility actually did so [128]. This gap could be partly explained by Theory of Planned Behavior which suggests that although a person's behavior is proximally influenced by their intention to perform the behavior, the actual behavior may not be completely based on their initial intentions [128]. Other studies suggested that this gap could be attributable to switching behavior [129, 130]. This is a reminder, for promoters of institutional delivery, that enhancing perceived need alone will not guarantee success and therefore insights into overcoming access barriers should be utilized to lay out a scheme which integrates a wide range of evidence into locally feasible plans and implementation.

At the same time, strategies should not overlook the importance of demand-side factors, which have been explored in other studies.

The present study has a number of limitations.

Firstly, not all annual NHSPA surveys included all provinces of Afghanistan. In some years, certain provinces were excluded due to security concerns. The facilities in the excluded provinces might have been systematically different from those that were included. This is a potential threat to external validity.

Second, the outcome variable was counts of facility deliveries. It does not include home deliveries cared for by skilled attendants. Therefore, the variable only partially captures utilization of delivery services by the community.

Third, hours of operation of health facilities could not be considered, due to lack of data. The hours were likely to differ between facilities, especially across different types of facility. For instance, a district hospital will operate around the clock, while smaller centers such as subcenters may have limited hours. This limitation may distort rates of institutional delivery.

Fourth, the study employed longitudinal data analysis methods. The methods separated cross sectional association and longitudinal association between response and predictor variables. Although the methods add to temporality which in turn strengthens assertions of causality, care must be taken when making causal claims.

Despite the limitations, the findings provide strong evidence that structural quality improvement of maternal health services was positively associated with increases in facility deliveries, suggesting that program efforts were yielding desired results. As envisioned, improvements in quality, when coupled with increased utilization, should contribute to lowering maternal and neonatal mortality and morbidity. Also, it was observed that improving structural quality and NGO support appeared to play a role in promoting facility deliveries in Afghanistan. This finding should stimulate continued investment and partnerships on health services in Afghanistan. This could contribute to the empirical evidence for policy makers and implementers in other countries who are aiming to realize maternal health gains, especially in a post-conflict setting.

6. Chapter (6): Is there any association between health workers' adherence to IMCI clinical guidelines for children under 5 years and the health workers' likelihood to provide accurate diagnosis of pneumonia and diarrhea?

Abstract

Background

Two of the main causes of child deaths in Afghanistan are pneumonia and diarrhea, both of which are treatable. Integrated Management of Childhood Illness (IMCI) is a strategy that is designed specifically to reduce childhood deaths due to these two conditions among others. The IMCI guidelines are designed to help health workers make accurate diagnoses, and appropriate decisions related to treatment and referral. This chapter estimates the associations between health workers' adherence to IMCI clinical guidelines and their likelihood to provide accurate diagnoses of pneumonia and diarrhea in children under 5 years of age.

Method

Data were obtained from the National Health Services Performance Assessment conducted across Afghanistan in 2012-13. The two conditions of pneumonia and diarrhea were assessed separately on systematic random samples of individual observations made in a stratified random sample of health facilities. The analysis for pneumonia was based on 1,742 observations of children between 2 months and 5 years of age, who presented with potential pneumonia symptoms to health workers in 581 unique facilities in 33 provinces of Afghanistan. The analysis for diarrhea drew on 1,239 observations of children under 5 years of age with diarrheal symptoms in 545 facilities across 33 provinces. The health provider's diagnoses were compared with those made by expert physicians ('gold' standard); this comparison was the basis for determining the odds of correct diagnosis and the odds of under-diagnosis (diagnosing a

condition as less severe than it actually was, thereby foregoing appropriate treatment). Because there may be clustering of health providers' practices and characteristics within a practice context, multilevel models with robust variance estimators were used to quantify the association between health workers adherence to IMCI clinical guidelines and their likelihood of correct diagnosis and under-diagnosis of pneumonia and diarrhea, after adjusting for certain individual-level and facility-level characteristics. Random intercepts were included to account for clustering at the province level and to separate the variation among within-province, between-province and the contextual effects of provincial characteristics on the health providers.

Results

It was found that 75% of children with acute respiratory infections and 62% of children with diarrhea were correctly diagnosed. Among children with pneumonia, including those with severe or very severe pneumonia, 37% were under-diagnosed; in contrast, among children with dehydrating diarrhea or dysentery, 46% were under-diagnosed. Within a given province, at the individual level, health workers with 10% higher score for adherence to the IMCI guidelines had a 9% (P=0.046) and 16% (P=0.013) reduction in the odds of under-diagnosis of pneumonia and diarrhea respectively. There was no association between adherence to guidelines and correct diagnoses of pneumonia (OR=1.06, P=0.145) or diarrhea (OR=1.07, P=0.188) at the individual level. At the province level, between-province effects (OR=1.77, P=0.001) and contextual effects (OR=1.67, P=0.003) of adherence to guidelines were statistically significantly associated with correct diagnosis of pneumonia, but not with correct diagnosis of diarrhea (between-province effects: OR=1.18, P=0.314, contextual effects: OR=1.11, P=0.56).

Conclusion

The results provide strong evidence of associations between adherence to IMCI guidelines by health workers and their likelihood of reaching an accurate diagnosis for pneumonia and diarrhea. The findings also pointed that there is considerable room to strengthen IMCI skills and performance of health workers to reduce under-diagnosis of children with serious illnesses.

Introduction

Despite the significant 56% reduction in the global rate of under-5 mortality from an estimated rate of 93 deaths per 1000 live births in 1990 to 41 deaths per 1000 live births in 2016, a recent report by WHO stated that 5.6 million children under the age of 5 died in 2016 [131]. The mortality amounted to 15,000 deaths per day. The same database reported that the latest under-5 mortality in Afghanistan was estimated to be 73 per 1000 live births, standing at more than twice the global rate. Globally, top causes of child deaths had been consistently occupied by pneumonia and diarrhea [132]. A report in 2016 indicated that pneumonia and diarrhea were responsible for 12.8% and 8.6% of worldwide under-5 deaths, occupying the first and third place respectively on causes of under-5 death [133]. A similar finding which highlighted the burden of pneumonia and diarrhea was reflected in studies done in Afghanistan. A report in 2010 identified that the most common cause of death for post-neonatal and early childhood period was acute respiratory infection, accounting for 35% and 23% respectively. For under-5 mortality, pneumonia accounted for 23.4 % of deaths and diarrhea 6.2% [51].

Since the Taliban government was toppled in 2001, Afghanistan has been revamping its efforts on rebuilding its devastated health system through the implementation of Basic Package of Health Service. BPHS was initiated in 2003, which was later complemented by integration with newly defined Essential Package of Hospital Services in 2005 [39]. Together, BPHS and EPHS formed the core of Afghan's major health care delivery system and referral chain. Since the outset of BPHS, maternal and child health was one of the focus areas of Afghanistan's strategies. In fact, maternal and child health occupied two out of seven elements described by BPHS. In its second element of Child Health and Immunization, BPHS explicitly identified Integrated Management of Childhood Illnesses as one of their strategic action points in an attempt to bring down its towering child death rates [40, 57].

IMCI is a strategy whose uptake was seen in 113 countries worldwide with varying levels of comprehensiveness [86, 94]. Targeting acute respiratory infections, diarrhea and other conditions commonly affecting children, IMCI remains the mainstream approach in tacking child mortality [134]. Multi-country studies evaluating the effects of IMCI have shown improvements in health service quality, reductions in mortality and the cost of child health care delivery [134].

Previous studies conducted in Afghanistan showed that process quality of pediatric care has improved over the years [94, 95]. In these studies, process quality, as measured by providers' overall compliance with IMCI standards, is used as a proxy for correct diagnosis (an indicator of outcome quality) due to the lack of 'gold standard' assessment to assess the accuracy of diagnosis given by the heath workers. However, in the 2012-2013 round of data collection of the National Health Service Performance Assessment, patients who were just seen by the health workers were re-examined by trained experts. Utilizing this newly available data, this chapter assesses the concordance between the two diagnoses given by the health workers and the experts, under the assumption that the expert diagnosis is the correct diagnosis, for the two common childhood illnesses of pneumonia and diarrhea. Then, the likelihood of this 'concordance' is assessed as a function of process quality of care, as measured by how well and closely health workers follow the clinical guidelines prescribed in IMCI trainings, adjusting for certain individual and facility level characteristics.

This chapter is divided into two sections: (6.1) for pneumonia and (6.2) for diarrhea, where the association between the adherence to guidelines and the odds of correct diagnoses for the two illness is explored separately. At the end of the chapter, a discussion section is written, unifying the findings from the two sections.

In this chapter, the following hypotheses were tested.

Section (6.1)

Null Hypothesis (6.1.1): There is no association between health workers' adherence to clinical guidelines and the likelihood of reaching a correct diagnosis for children aged between 2 months and 5 years presenting with ARI symptoms.

Alternative hypothesis (6.1.1): Health workers' adherence to clinical guidelines is associated with the likelihood of reaching a correct diagnosis for children aged between 2 months and 5 years presenting with ARI symptoms.

Null Hypothesis (6.1.2): There is no association between health workers' adherence to clinical guidelines and the likelihood of under-diagnosis for children aged between 2 months and 5 years presenting with ARI symptoms.

Alternative hypothesis (6.1.2): Health workers' adherence to clinical guidelines is associated with the likelihood of under-diagnosis for children aged between 2 months and 5 years presenting with ARI symptoms.

Section (6.2)

Null Hypothesis (6.2.1): There is no association between health workers' adherence to clinical guidelines and the likelihood of reaching a correct diagnosis for children under 5 presenting with diarrhea symptoms.

Alternative hypothesis (6.2.1): Health workers' adherence to clinical guidelines is associated with the likelihood of reaching a correct diagnosis for children under 5 presenting with diarrhea symptoms.

Null Hypothesis (6.2.2): There is no association between health workers' adherence to clinical guidelines and the likelihood of under-diagnosis for children under 5 presenting with diarrhea symptoms.

Alternative hypothesis (6.2.2): *Health workers' adherence to clinical guidelines is associated with the likelihood of under-diagnosis for children under 5 presenting with diarrhea symptoms.*

6.1. Section (6.1) Adherence to clinical guidelines and Accurate diagnosis of Pneumonia

Methodology

Sample

The analysis was based on observations on a systematic random sample of 1,742 children between 2 months and 5 years of age who presented with potential pneumonia symptoms to a stratified random sample of subcenters, BHCs, CHCs amounting to 581 unique facilities in 33 provinces of Afghanistan in 2012-2013 round of data collection.

Data Source

All the data used in this chapter was based on the National Health Services Performance Assessment in Afghanistan.

For the outcome variable of accurate diagnosis, the data was extracted from Forms 1 and 3 of the 2012-2013 round of the National Health Services Performance Assessment and re-examination data set. Yearly data collection of NHSPA always included observation of clinical encounters of health workers with children and exit interviews with their caretakers since 2004. However, re-examination by experts was done only in the 2012-13 round of data collection, on which analyses of this chapter drew.

Data from Form 7 of NHSPA is merged with data from Forms 1 and 3 so that the analysis could utilize information collected from the facility assessment on Form 7.

The following forms provides necessary data for the main explanatory variable and other covariates.

Form 1*	Observation for New patient under 5 years
Form 3*	Exit interview for New patient under 5 years
Form 7	Facility assessment (BHCs, CHCs, Sub-centers)

*Form 1 and 3 are generally regarded as a pair.

Table 6.1 Forms used for section 6.1

Case Selection

In the original dataset of Forms 1 and 3, there were 3,516 clinical observations in total which span all 34 provinces of Afghanistan. Data from Form 7 which contained information on health facility assessment were merged with the Forms 1 & 3 dataset, matching on facility ID number using the command m:1 (multiple to single). Children under 2 months of age are excluded from the analysis, based on IMCI training guidelines [29]. It resulted in 3,330 clinical interactions observed in 685 facilities across 34 provinces. Out of these, 1849 observations were found to present with cough, shortness of breath or wheezing, either to the health workers or the experts or both.

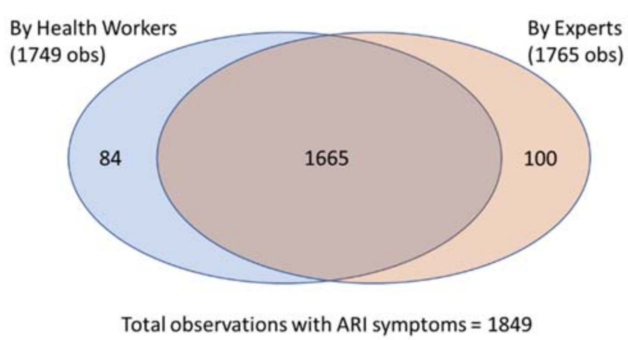


Figure 6.1 Number of cases presenting with ARI symptoms to health workers and/or experts

107 observations (5.79% of total eligible observations) contained missing values for some of the variables. They are excluded from the analysis after careful consideration. Therefore, the final analysis is a complete case analysis based on 1742 interactions which spanned across 581 facilities in 33 provinces.

	Original dataset before dropping Missing			Final Working Dataset		
year	Provinces	Facilities	Observations	Provinces	Facilities	Observations
2012-2013	33	614	1849	33	581	1742

Table 6.2 Sample of children presenting with ARI symptoms before and after dropping observations with missing information in any of the variables

Operationalization of Variables

Section (6.1) Outcomes of interest: Making accurate diagnoses for ARI

Acute respiratory infection and diarrhea perpetually occupy top positions in causes of child deaths every year [132]. The Integrated Management of Childhood Illness (IMCI) guidelines established clinical criteria to diagnose and classify these two diseases among many other. Making correct diagnosis and classification of the conditions/diseases are important because the clinical management, ranging from treatment choices to clinical counselling and referral decisions, depends on them. Therefore, accurate diagnosis lies at the heart of clinical management of the sick child and bringing down child mortalities.

For certain diseases, gold standards for assessing the accuracy of clinical diagnosis made by health workers include laboratory investigations and tests. For instance, the accuracy of clinical diagnosis for HIV suspected infants can be assessed by the use of an HIV enzyme-linked immunosorbent assay. However, the severity of conditions such as ARI and diarrhea are not usually assessed by lab tests but clinically, especially in low-resource settings where the access to lab services is severely limited.

There were two outcomes of interest. The primary outcome of interest was the accurate diagnosis while the secondary outcome of interest was under-diagnosis.

Correct diagnosis of pneumonia: The operational definition for correct diagnosis for the purposes of this study was the concordance between the diagnosis given by the health worker observed and the diagnosis given by the expert. In other words, the disease category given by the health worker was considered correct if it was the same as that given by the expert.

The IMCI guidelines classified ARI into four categories: No pneumonia, Pneumonia, Severe Pneumonia and Very Severe Pneumonia. However, the treatment guidelines for basic clinical staff were similar for severe pneumonia and very severe pneumonia, i.e. to give the first dose of an appropriate antibiotic and refer urgently to the hospital [135]. In this light, severe pneumonia and very severe pneumonia were merged and treated as a single category. Therefore, the construction of the variable for accurate diagnosis for ARI was based on only 3 categories : (1) no pneumonia, (2) pneumonia and (3) severe or very severe pneumonia. The diagnosis was only counted as correct when the diagnosis of the health worker is in the same category as that of the expert.

Based on these disease categories, a binary variable 'correct diagnosis' is constructed. When the two diagnoses coincide, it is regarded as 1. If not, 0.

<u>Under-Diagnosis of pneumonia</u>: Under-diagnosis, for the purpose of this study, was defined as the situation where the health worker reached at a disease category less severe than that of the experts. For instance, if the health worker gave the diagnosis of pneumonia or no pneumonia for a patient whom experts diagnose as severe/very severe pneumonia, it was regarded as a case of under-diagnosis. Under-diagnosis was important because it meant that the health worker treated the condition less seriously than it actually deserved. Consequently, under-diagnosis could lead to under-treatment. Under-diagnosis was, to some extent, similar to the concept of false-negative. For example, IMCI guidelines prescribes urgent referral to hospitals for severe/very severe pneumonia cases but not for non-severe pneumonia or no pneumonia cases. If the health worker under-diagnosed a severe/very severe case of pneumonia as a non-severe pneumonia or no pneumonia, she/he would not initiate the referral process. This might translate into a life-threating situation for the patient.

Section (6.1) Main Explanatory variable: Adherence to IMCI clinical guidelines by health workers

The adherence to IMCI clinical guidelines by health workers was operationalized by a composite score. The variable drew on observations of clinical encounters at the facility between patients and providers as recorded in the National Health Service Performance Assessments. The measure was based on whether health care providers followed steps described in IMCI management guidelines, especially the items necessary to correctly diagnose and categorize ARI.

The composite score was composed of 8 mandatory items and 5 skip-pattern-related items, which made the maximum possible score 13. The mandatory items included those which must be assessed regardless of whether the patient presented with cough or not. These mandatory items were based on the IMCI guidelines. Most of mandatory items were essential in assessing general danger signs of the child patient, which in turn affected the categorization of the ARI. The 5 skip-pattern-related items were based on whether the health worker asked about cough as well as whether the patient had cough or not. The following table details the items used to calculate the score.

	Mandatory Items		**Skip-pattern-dependent items**
1	Q110 – Patient age asked		*If coughing was present*
2	Q112 – asked about the nature of complaint	**1**	q125a – asked how long
3	Q115 – duration of primary complaint asked	**2**	q125b – asked about stridor/wheezing
4	Q116 – asked if able to drink/breastfeed	**3**	q125c – checked breathing rate
5	Q117 – asked if vomit	**4**	q125d – lifted shirt
6	Q118 – checked lethargy/consciousness	**5**	q125e – listened with stethoscope
7	Q119 - asked about convulsions		
8	Q124- asked about coughing		

Table 6.3 *Items used to construct the composite score of adherence to guidelines by health workers for pneumonia*

These binary items were then converted into a percentage score. As the number of skip pattern related items varied case by case, the denominator, which denoted the number of all relevant items for a case, varied as well.

Some of the items used in the construction of the score were found to have some missing data. Rather than leaving them out from the analysis, attempts were made to utilize as much data as possible from these observations. This was made possible by changing the denominator of the score in accordance with the number of items with missing data. For example, the denominator of the observation with no missing data on all of the items is 13 whereas that of the observation with missing data on 3 of the items was set at 13 – 3 = 10.

Section (6.1): Covariates

An Afghanistan study conducted in 2009 by Edward et al. [94] reported that the clinical diagnosis of IMCI assessment was affected by type of health worker, knowledge score, mechanism of contracting services and duration of consultation time. Also, the age of the child and the sex of the caretaker were found to be associated with assessment quality. Counselling quality was associated with the same characteristics except for type of provider and child age. At the facility level, it was reported that quality of care was associated with presence of clinical guidelines and the frequency of supervision.

Another similar study conducted in 2012 but with the focus on health workforce capacity reported that quality of care for IMCI indices improved with availability of doctors, IMCI training, provider knowledge, factors such as provider job satisfaction, availability of clinical guidelines, frequency of supervision and presence of community councils (Shura-e-Sehie) [95].

Based on previous literature and availability of data, the following covariates were used for SA (2.1):

Individual Level Factors

- type of health worker
- sex of health worker
- whether the health worker has received IMCI training
- time spent with patients

Supply-side

- age of patient
- sex of patient
- sex of care taker

Demand-side

Facility Level Factors

- Type of health facility
- Volume of health services
- Presence of clinical guidelines
- Evidence of supervision
- Managing organizations/ contracting mechanism

Analysis

Analysis Outline

Secondary data analysis was done entirely in STATA version 14(97).

Exploratory data analysis was done to study missingness extent and distribution. Univariate analysis was done to explore summary characteristics of observations which were documented using descriptive statistics.

Hierarchical bivariate and multivariate logistical regression models were used to study the association between adherence to clinical guidelines by health workers and the likelihood to reach at correct diagnosis for ARI. Random intercepts were included to separate between-province, within-province and contextual effects.

The between-province, within-province and contextual effects were mathematically estimated using the following regression models:

Model (A): $\text{LogOdds}\,(Y_{ij} = 1 \mid X_{ij}, \bar{X}_{i.}) = \alpha_{1i} + \beta_1 X_{ij} + \gamma_1 \bar{X}_{i.}$

Model (B): $\text{LogOdds}\,(Y_{ij} = 1 \mid X_{ij}, \bar{X}_{i.}) = \alpha_{2i} + \beta_2 (X_{ij} - \bar{X}_{i.}) + \gamma_2 \bar{X}_{i.}$

, where Yij = accurate diagnosis indicator

$\alpha_1 i$, $\alpha_2 i$ = province-specific intercepts for model A and B

X_{ij} = adherence score of health worker j in province i

$\overline{X}_{i.}$ = mean adherence score in province i

LogOdds ($Y_{ij} = 1 \mid X_{ij}, \overline{X}_{i.}$) = log $\left(\frac{\Pr(Yij=1 \mid \alpha ki, Xij)}{\Pr(Yij=0 \mid \alpha ki, Xij)}\right)$= $\alpha_{ki} + \beta_k X_{ij}$ + ...

$\alpha_{ki} \sim N(\alpha_k, \tau_k^2)$, for each model k.

The models were constructed in such a way that γ_K represents contextual effect in model A and between-province effect in model B. B_k represents the within-province effect in model B.

Findings

Assessing Missingness

Analysis was done to assess the extent and patterns of missing values. In the original dataset, there were 3,516 observations of patient-provider interaction. The exclusion of children under 2 months of age gave rise to 3330 observations. Of these, observations that were missing in one or more of relevant variables were assessed. The table below lists the extent of the missing variables.

Items 14 to 25 were used to construct covariates. Some of these variables showed missingness. They accounted for 3.21% (107 observations) of all the eligible 3330 observations. These 107 observations were excluded from the analysis after careful consideration. After selecting those presenting with potential ARI symptoms, the final effective sample for a complete case analysis included 1742 observations in 581 unique facilities in 33 provinces. (Note: Afghanistan has 34 provinces. Observations in Nuristan Province did not cover any cases presenting with cough, difficult breathing or wheezing.)

Items 1 to 13 were used to construct the predictor variable “compliance score.” Instead of dropping those with incomplete information from analysis, the remaining available information from these items were used. This was possible because the compliance score was constructed to be a percentage score. (For more detail for construction of variables, see the section above “Operationalization of Variables.”)

	Items	**variable**	**Count missing**	**% missing**
1	Patient age asked	q110	0	0.00%
2	asked about the nature of complaint	q112	0	0.00%
3	duration of primary complaint asked	q115	2	0.06%
4	asked if able to drink/breastfeed	q116	3	0.09%
5	asked if vomit	q117	0	0.00%
6	checked lethargy/consciousness	q118	2	0.06%
7	asked about convulsions	q119	5	0.15%
8	asked about coughing	q124	0	0.00%
	Ask If cough present			
9	asked how long	q125a	168	5.05%
10	asked about stridor	q125b	168	5.05%
11	checked breathing rate	q125c	168	5.05%
12	lifted shirt to examine	q125d	168	5.05%
13	listened with stetho	q125e	168	5.05%
14	Age of the patient	ptagemonths	0	0.00%
15	Sex	q107	0	0.00%
16	Relationship with caretaker	f3q104r	8	0.24%
17	Sex of the health worker	q106	2	0.06%
18	Type of the health worker	q105	0	0.00%
19	Health worker received IMCI training	q106a	3	0.09%
20	Time spent on consultation	q153a	1	0.03%
21	Type of health facilities	q104ft	0	0.00%
22	Presence of clinical guidelines	q900	0	0.00%
23	Had supervision within last 3 months	q1501ab	3	0.09%
24	Volume of health services	volservice	90	2.70%
25	Managing agency	q111m	0	0.00%
	Missing in any of the above		107	3.21%

Table 6.4 Extent of missingness in the dataset for pneumonia

Exploration of the variables

The average number of observations in each province was 53 (range: 7 to 96). The median was 57, meaning that more than half of provinces have at least 57 observations each. The province with the most number of observations was Baghlan with 96 cases and Badghis reported the fewest observations, 7.

It was found that 1742 selected observations occurred in 581 unique facilities. The average number of observations per facility was 3 (range: 1 to 6). The median was also 3. This does not provide enough variability to follow the originally proposed plan of a 3-level analysis, 3 levels being province, facility and individual levels. Instead, a 2-level hierarchical model (province-level and individual-level) was considered.

Table (6.5) below illustrates the correct and under- diagnoses in each category of the ARI classification. Correct diagnoses are described in green cells while under-diagnoses are highlighted in red. The percentages were cell percentages unless otherwise specified.

Out of 1742 observations, the health workers were able to correctly diagnose 1304 (74.9%) of them. There were 1313 no pneumonia cases and the health workers were able to correctly categorize 1041 cases (80.3%) of them. 387 pneumonia cases were identified by experts and the health workers correctly identified 252 cases (65.1%) of them. Out of 42 severe or very severe pneumonia cases, the health workers gave a correct diagnosis for 11 cases (26.2%). It was noted that the percentage correctly identified by the health workers decreased as the disease severity worsened – from 80.3% in no pneumonia cases to 65.1% in pneumonia cases and 26.2 in severe/very severe pneumonia cases.

279 cases (16.0%) were over-diagnosed, i.e. categorized as a more severe condition than it actually was, while 159 cases (9.1%) were under-diagnosed, i.e. the health worker falsely reached at a lower disease category. It was also noted that the health workers over-diagnosed (16% of total diagnoses) more than they under-diagnosed (9.1% of total diagnoses).

		Expert Diagnosis			
		No pneumonia	Pneumonia	Severe or very severe pneumonia	Row total (row %)
Health Worker Diagnosis	No pneumonia	**1041 (59.8%)**	**128 (7.4%)**	**20 (1.2%)**	*1189 (68.3%)*
	Pneumonia	**263 (15.1%)**	**252 (14.5%)**	**11 (0.6%)**	*526 (30.2%)*
	Severe/very severe pneumonia	**9 (0.5%)**	**7 (0.4%)**	**11 (0.6%)**	*27 (1.6%)*
	Column Total (Column %)	*1313 (75.4%)*	*387 (22.2%)*	*42 (2.4%)*	*1742 (100%)*
	Correct diagnosis by health workers	**1041 (80.3% of No Pneumonia)**	**252 (65.1% of Pneumonia)**	**11 (26.2% of Severe/V. Severe Pneumonia)**	**1304 (74.9% of total)**
	Over-diagnosis by health workers	272 (20.7% of No Pneumonia)	7 (1.8% of Pneumonia)	-	279 (16.0% of total)
	Under-diagnosis by health workers	**-**	**128 (33.1% of Pneumonia)**	**31 (73.9% of Severe/V.severe Pneumonia)**	**159 (9.1% of total)**

Table 6.5 Accuracy of diagnoses for pneumonia by health workers

Summary Characteristics

Characteristics	Individual-level	Facility-level	Province-level
	Average (SD)/ Count (%)	Count (%)	Median (min, Q1, Q3, max)
	n = 1742	n = 581	n = 33
Correct Diagnosis	1304 (74.86%)		77% (22%, 61%, 88%, 95%)
Under-diagnosis	159 (9.13%)		7% (0%, 4%, 14%, 52%)
Adherence score to guidelines	0.64 (0.18)		0.63 (0.43, 0.58, 0.71, 0.79)
Age of patient (months)	21.51 (14.52)		21 (16, 19, 24, 31)
Sex of the patient (male)	963 (55%)		54% (40%, 50%, 60%, 70%)
Relationship with caretaker			
Mothers	1405 (81%)		82% (48%, 77%, 85%, 100%)
Non-mothers	337 (19%)		17% (0%, 15%, 23%, 52%)
Sex of the health worker (male)	1632 (94%)		98% (70%, 90%, 100%, 100%)
Type of health worker			
Doctors	838 (48%)		48% (0%, 29%, 60%, 98%)
Nurses	727 (42%)		47% (0%, 35%, 52%, 87%)
Midwife & others	177 (10%)		7% (0%, 4%, 13%, 38%)
Health Worker received IMCI training			
Yes within last 12 months	271 (16%)		8% (0%, 0%, 24%, 72%)
Yes but not within 12 months	767 (44%)		40% (14%, 28%, 57%, 73%)
No IMCI training	704 (40%)		43% (0%, 23%, 61%, 86%)
Time spent on consultation (mins)	6.63 (3.24)		6 (3, 6, 8, 11)
Type of Health Facilities			
BHC		901 (52%)	51% (14%, 39%, 60%, 72%)
CHC		498 (29%)	28% (9%, 22%, 36%, 60%)
Subcenter or smaller		343 (19%)	20% (2%, 14%, 30%, 43%)
Clinical guidelines present		1579 (91%)	93% (50%, 83%, 100%, 100%)
Supervision within last 3 months		1602 (92%)	95% (57%, 88%, 100%, 100%)
Volume of health services		10739 (7036)	10105 (5601, 7786, 13207, 20729)
Managing Agency			
MOPH, without support		64 (4%)	0% (0%, 0%, 0%, 83%)
MOPH, with support		891 (51%)	23% (0%, 0%, 96%, 100%)
NGO only		787 (45%)	14% (0%, 0%, 100%, 100%)

Table 6.6 Summary characteristics of variables for analysis for pneumonia

Table (6.6) presents results from exploratory data analysis on some of the variables used in the regression analysis. Variables were presented at their relevant levels as well as at clustered levels. At the individual/facility level, the mean and the standard deviation were described for continuous variables, and the count and proportion for categorical variables. At the province level, the median of the mean count/proportion (depending on whether they were continuous or categorical) were tabulated. The range and the interquartile range were also described to better understand the distribution of the variables across provinces.

At the individual level, correct diagnoses of pneumonia occurred in 74.86 percent of all the observations. At the province level, half of all provinces reported a mean correct diagnosis proportion of 77% or higher. Some province reported a mean proportion of correct diagnosis as low as 22% where the maximum mean provincial correct diagnosis proportion stood at 95%. The interquartile range was also described, in this case 61% and 88%.

Under-diagnosis of pneumonia was found in 9.13% of all observation of potential cases of pneumonia. 50% of provinces reported a mean proportion of under-diagnosis of 7% or lower. Certain provinces reported no cases of under-diagnosis.

Out of all 1742 observations, 62 observations (3.56%) had a perfect score of 1, i.e., the health workers followed the chosen items from the IMCI guideline perfectly. The average score was 0.64 with a standard deviation of 0.18. The median was 0.62, with the interquartile range being from 0.54 (Q1) to 0.77 (Q3). Half of provinces recorded a mean adherence score of 0.63 or higher. The range was 0.43 to 0.79. It was observed that the adherence score was not as variable as correct diagnosis or under-diagnosis.

The average age of the children observed was 21.51 months, 55 percent of whom were males. 81% of the children were brought to the clinic by their mothers.

An overwhelmingly 94% of the health workers who saw these patients were males. Doctors and assistant doctors accounted for 48% of the observations and nurses 42%. “Midwife and others” category included midwives, community midwives, community health workers and others, and they accounted for 10% of the observed workforce. 16% of the studied workforce received IMCI training within the last 12 months. The majority of the health (44%) workers answered that they attended IMCI trainings but not within the last 12 months. The other 40% had no IMCI training at all. It was observed that the health workers spent an average of 6.63 minutes when consulting and clinically examining the children.

More than half of the observations (52%) occurred in basic health facilities. 29% occurred in a more advanced comprehensive health centers and the remainder 19% in subcenter or smaller facilities. IMCI chartbooks or wall charts were present in 91% of the health facilities. Evidence of supervision was found in 92% of the facilities. The average volume of services provided (new cases + re-attendance) per month was 10739 (standard deviation = 7036). A mere 4% of the facilities surveyed were managed by MOPH without any external support while 51% were managed by MOPH with support. The other 45% were managed by NGOs only.

Fitting Random Intercepts Logistics Model with No Covariates for Pneumonia (Unadjusted)

	Odds	**Std Error**	**P value**	**Estimated Proportion (Odds/1+Odds)**	**Observed Mean proportion**	**Observed Median proportion**
Correct Diagnosis	3.56	0.44	<0.001	0.78	0.75	0.77
Under-Diagnosis	0.10	0.01	<0.001	0.09	0.09	0.07

Table 6.7 Comparison of estimated proportions of correct diagnosis and under-diagnosis of pneumonia from random intercept logistic models with no covariates with respective observed proportions

A random intercept logistics model with no covariates was fitted. Sensitivity analysis for integration points was conducted. It was found that results were stable at 7 integration points. As there were no covariates in the model, the results could be interpreted as follows:

For a typical province, i.e. for an average province or provinces with the random intercept $b_{oi} = 0$

the estimated odds of correct dx = 3.56

the estimated proportion of health workers who correctly diagnose = 3.56/ (1+ 3.56) = 0.78

It was noted that the estimated proportions of correct diagnosis and under-diagnosis were similar to observed values, as described in table (6.7).

Sensitivity, Specificity, PPV and NPV of Health Workers' Diagnoses for Pneumonia

	No Pneumonia VS Pneumonia/Severe Pneumonia (A)	No Pneumonia/ Not Severe VS Severe Pneumonia (B)
Sensitivity	66%	26%
Specificity	79%	99%
Positive Predictive Value	51%	41%
Negative Predictive Value	88%	98%

Table 6.8 Sensitivity, specificity, positive predictive values and negative predictive values of health workers' in differentiating different disease categories for pneumonia

Table (6.8) tabulates the sensitivity, specificity, positive predictive values and negative predictive values of health workers' diagnoses. Column (A) differentiated pneumonia cases against no pneumonia cases. In treatment terms, it meant cases who received antibiotics against who did not. Column (B) differentiated between severe and not severe cases of ARI. In reality, this would be translated into whether the patients were referred to a hospital or not.

It was noted that only 66% of cases with pneumonia cases were correctly identified by health workers, i.e. only 66% of cases which warranted the use of antibiotics were diagnosed as so in the facilities. In other words, health workers missed prescribing antibiotics in 34% of patients presenting with pneumonia symptoms. Another noteworthy finding was the sensitivity in Column (B) which showed that only 26% of cases that should have been referred to a higher-level facility were categorized as so by health workers, i.e. health workers missed referring 74% of patients who should have been urgently referred.

Bivariate Analysis for correct diagnosis of Pneumonia after accounting for clustering at the province level

	Odds Ratio	Std Err	P value	95%	CI
Adherence to guidelines (10% increase)	1.22	0.05	<0.001	1.13	1.32
Age of patient (months)	1.00	0.00	0.543	0.99	1.01
Sex of the patient (ref: female)	-	-	-	-	-
male patient	1.12	0.13	0.340	0.89	1.42
Relationship with caretaker (ref: Mothers)	-	-	-	-	-
Non-mothers	1.27	0.20	0.135	0.93	1.72
Sex of the health worker (ref: female)	-	-	-	-	-
male health worker	1.44	0.34	0.116	0.91	2.28
Type of health worker					
(ref: Doctors)	-	-	-	-	-
Nurses	0.58	0.08	<0.001	0.44	0.77
Midwife & others	0.25	0.05	<0.001	0.17	0.37
Health Worker received IMCI training					
(ref: No IMCI training)					
Yes within last 12 months	1.85	0.39	0.003	1.22	2.79
Yes but not within 12 months	1.69	0.23	<0.001	1.29	2.21
Time spent on consultation (mins)	1.11	0.03	<0.001	1.06	1.17
Type of Health Facilities					
(ref: BHC)	-	-	-	-	-
CHC	1.21	0.17	0.187	0.91	1.60
Subcenter or smaller	0.96	0.15	0.801	0.70	1.31
Clinical guidelines (ref: not present)					
Present	1.18	0.25	0.428	0.78	1.79
Supervision within last 3 months (ref: no evidence)	-	-	-	-	-
evidence of supervision	1.38	0.30	0.141	0.90	2.11
Volume of health services (1000 increase in services)	1.00	0.01	0.932	0.98	1.02
Managing Agency					
(ref: MOPH, with support)	-	-	-	-	-
MOPH, without support	0.89	0.40	0.792	0.36	2.17
NGO only	0.70	0.18	0.165	0.43	1.16

Table 6.9 Results from bivariate Analysis for correct diagnosis of pneumonia after accounting for clustering at the province level

The above table lists the results from bivariate analyses after adjusting for clustering at the province level due to the multistage survey design.

Adherence to IMCI clinical guidelines, the main predictor of interest, was found to be statistically significantly associated with accurate categorization of ARI conditions (P<0.001). For every 10 percent increase in the adherence score, the odds of reaching at a correct diagnosis is increased by 22 percent (95% CI = 1.13, 1.32).

The other covariates that were of significant association at the α level of 0.05 were type of health workers, whether health workers received IMCI training in the past and the amount of time the health worker spent with the patients during consultation sessions.

Doctors and assistant doctors seemed to be able to better diagnose ARI conditions. Compared to doctors, nurses had a 42% lower odds of correct diagnosis (P<0.001) while midwives and other health workers presented a 75% lower odds (P<0.001).

Training of IMCI apparently played a role. For health workers who received IMCI training in the last 12 months, there was an 85% increase in the odds of correct diagnosis (P=0.003). If the training was more than a year ago, the increase in the odds was 69% (P<0.001), compared with those who had no training.

The average time the health workers spent per patient was 6.63 mins. The bivariate analysis reported that the health worker who spent one more minute was expected to experience an increase in the odds of a correct diagnosis by 11 percent (P<0.001).

Bivariate Analysis for under-diagnosis of Pneumonia after accounting for clustering at the province level

	Odds Ratio	Std Err	P value	95%	CI
Adherence to guidelines (10% increase)	0.87	0.04	0.006	0.79	0.96
Age of patient (months)	1.00	0.01	0.622	0.99	1.01
Sex of the patient (ref: female)					
male patient	0.63	0.10	0.004	0.47	0.87
Relationship with caretaker (ref: Mothers)					
Non-mothers	1.43	0.20	0.011	1.09	1.89
Sex of the health worker (ref: female)					
male health worker	1.18	0.35	0.576	0.66	2.12
Type of health worker					
(ref: Doctors)					
Nurses	1.12	0.22	0.557	0.76	1.66
Midwife & others	1.64	0.63	0.198	0.77	3.48
Health Worker received IMCI training					
(ref: No IMCI training)					
Yes within last 12 months	0.84	0.29	0.624	0.43	1.66
Yes but not within 12 months	0.69	0.13	0.056	0.47	1.01
Time spent on consultation (mins)	0.96	0.04	0.261	0.89	1.03
Type of Health Facilities					
(ref: BHC)					
CHC	0.88	0.22	0.619	0.53	1.45
Subcenter or smaller	1.09	0.19	0.616	0.77	1.55
Clinical guidelines (ref: not present)					
Present	0.83	0.27	0.574	0.44	1.57
Supervision within last 3 months (ref: no evidence)					
evidence of supervision	0.90	0.26	0.727	0.51	1.59
Volume of health services (1000 increase in services)	1.00	0.01	0.886	0.97	1.03
Managing Agency					
(ref: MOPH, with support)					
MOPH, without support	0.80	0.41	0.663	0.30	2.17
NGO only	0.79	0.24	0.446	0.43	1.45

Table 6.10 Results from bivariate Analysis for under-diagnosis of pneumonia after accounting for clustering at the province level

Results from table (6.10) demonstrates that the more the health worker follows the guidelines, the less they are likely to reach at an under-diagnosis. For every 10 percent increase in adherence to IMICI guidelines, there was a 13% reduction in the odds of reaching at an under-diagnosis (P = 0.006).

The other variables that were statistically associated with under-diagnosis was sex of the patient and who was bringing the patient for care. If the child being assessed was a boy, his odds of having an under-diagnosis was reduced by 37 percent. If the child was brought into the facility by someone who was not her/his mother, the odds of being under-diagnosed increased by 43%.

The variables that were of significance for accurate diagnosis, type of health workers and whether the health worker underwent IMCI training in the past, were not statistically significant here at the α level of 0.05.

Separation of Between, Within and Contextual Effects

Previous literature stated that there was variation in quality of health services between provinces of Afghanistan[54, 94, 102]. Therefore, it was sensible to explore the variation of the distribution of the outcome variables, correct diagnosis and under-diagnosis of ARI, between provinces. The following is the graphical representation of the variation of the outcome variables across provinces.

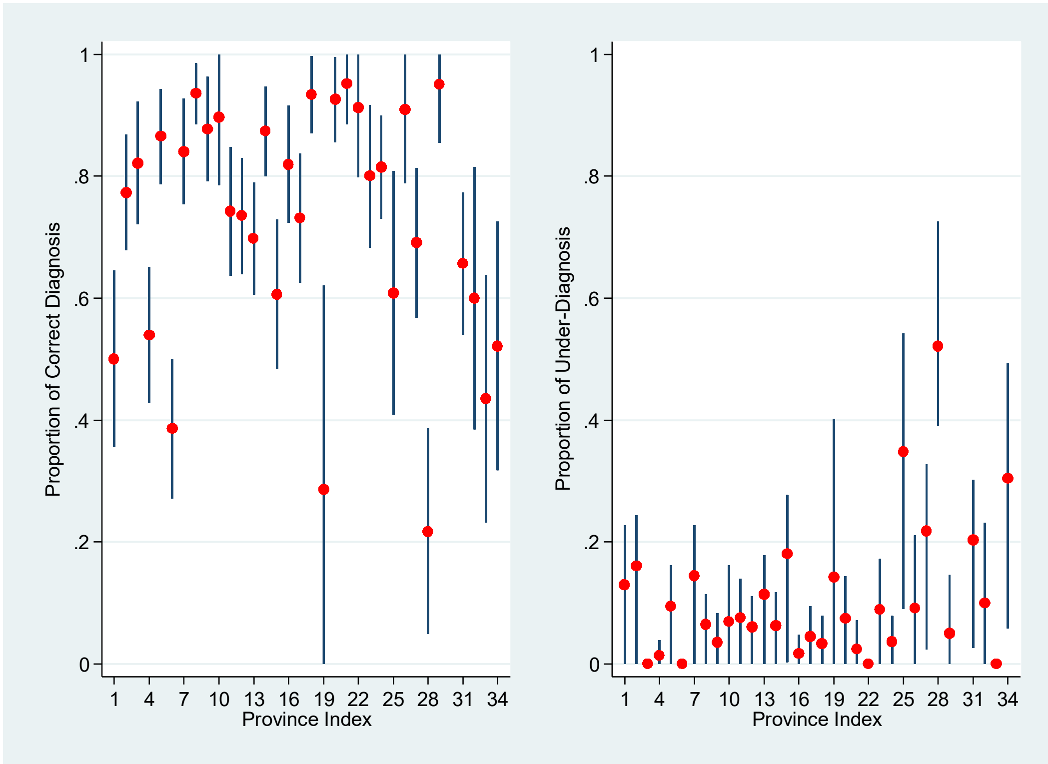


Figure 6.2 Proportions of mean correct diagnosis and under-diagnosis of pneumonia across provinces with 95% CI

The red dots and the lines represented the mean proportions of the correct and under- pneumonia diagnoses and the 95% confidence intervals for each province respectively. It appeared that there was a certain degree of heterogeneity in the proportion of correct diagnosis across the provinces. (Note: Province 19 which had the widest confidence interval was Badghis where only 7 observations were made.)

The following table illustrates the results from model A and B both of which only included adherence to clinical guidelines as the predictor with no other covariates.

	Correct Diagnosis of Pneumonia				**Under-diagnosis of Pneumonia**			
	OR	P value	(95%	CI)	OR	P value	(95%	CI)
Within effect	1.19	<0.001	1.10	1.28	0.90	0.0320	0.82	0.99
Between effect	2.10	<0.001	1.82	2.43	0.60	0.0020	0.43	0.83
Contextual effect	1.77	<0.001	1.53	2.06	0.67	0.0190	0.47	0.94

Table 6.11 Within, between, contextual effects of correct and under-diagnosis of pneumonia

The models were constructed in such a way that γ_K represents the contextual effect in model A and between-province effect in model B. B_k represents the within-province effect in model B.

For Correct Diagnosis of Pneumonia

Within-province effect can be interpreted as the expected difference in odds ratio of correct diagnosis between two health workers from the same province but who differ in adherence score by 10 percent. For a given province, the odds of correct diagnosis of a health worker increased by 19% with every 10 percent increase in adherence score (P<0.001).

Between-province effect can be interpreted as the expected difference in the mean odds ratios of correct diagnosis between two provinces which differ by 10 percentage points in their mean adherence score. In this case, the mean odds of correct diagnosis of a province increased by 110% with every 10 percent increase in mean provincial adherence score (P<0.001).

When the Wald chi square test was conducted to see if the between-province effect was statistically different from the within-province effect, the test was positive with a chi square statistic of 107.8 (P<0.001).

Contextual effect can be interpreted as the expected difference in the odd ratios between two health workers with the same adherence score but who come from two provinces that differ in average adherence score by 10 percent. The finding suggests that for two health workers who had the same adherence score, their odds of reaching a correct diagnosis would differ by 77% if the province they were in differed in mean adherence score by 10 percent (P<0.001).

For Under-Diagnosis of Pneumonia

Contextual, within- and between- province effects for under-diagnosis can be interpreted similarly as in correct diagnosis.

Within-province effect was not statistically significant at $\alpha=0.05$ (P=0.08).

Between-province effect If the two provinces differed by 10% in their mean provincial adherence score, the health worker from the province with the higher score could expect to have a 40% reduction in the odds of an under-diagnosis.

A Wald chi square test was positive between the within- and between-province effects, with a chi square statistic of 14.82 and a p-value of 0.19.

Contextual effect If we compare two health workers who had the same adherence score, the health worker who came from a province that had a 10% higher mean provincial score for adherence could expect a 33% statistically significant reduction in under-diagnosis of pneumonia (P=0.047).

Multivariate Random Intercepts Logistics Model with Covariates for Pneumonia

	Correct Diagnosis of Pneumonia								Under-diagnosis of Pneumonia							
	With individual-level covariates				With individual- & facility-level covariates (Full Model)				With individual-level covariates				With individual- & facility-level covariates (Full Model)			
	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)
Adherence Score-10 percent increase																
(within-province effect)	1.06	0.133	0.98	1.15	1.06	0.145	0.98	1.14	0.91	0.030	0.83	0.99	0.91	0.046	0.84	1.00
(between-province effect)	1.77	0.001	1.26	2.49	1.83	0.016	1.12	2.99	0.85	0.523	0.51	1.40	0.68	0.211	0.38	1.24
(contextual effect)	1.67	0.003	1.19	2.34	1.73	0.034	1.04	2.85	0.93	0.799	0.56	1.57	0.75	0.351	0.41	1.38
Patient age (months)																
(within-province effect)	1.00	0.292	1.00	1.01	1.00	0.319	1.00	1.01	0.99	0.362	0.98	1.01	0.99	0.392	0.98	1.01
(between-province effect)	1.01	0.623	0.97	1.06	1.05	0.191	0.98	1.12	0.89	0.068	0.78	1.01	0.88	0.036	0.79	0.99
(contextual effect)	1.01	0.783	0.96	1.05	1.04	0.240	0.97	1.12	0.89	0.085	0.78	1.02	0.89	0.049	0.79	1.00
Sex of patient (Ref: female)																
Male patient (within-province effect)	1.13	0.281	0.90	1.42	1.14	0.232	0.92	1.43	0.61	0.003	0.44	0.84	0.61	0.002	0.44	0.84
(between-province effect)	0.83	0.114	0.65	1.05	1.02	0.909	0.73	1.42	1.00	0.995	0.54	1.85	0.96	0.899	0.54	1.73
(contextual effect)	0.82	0.091	0.64	1.03	1.01	0.972	0.72	1.40	1.05	0.871	0.57	1.95	1.01	0.968	0.56	1.83
Type of caretakers (Ref: mothers)																
Non-mothers (within-province effect)	1.22	0.316	0.83	1.79	1.21	0.329	0.82	1.78	1.49	0.023	1.06	2.10	1.52	0.018	1.08	2.14
(between-province effect)	0.83	0.006	0.72	0.95	0.87	0.283	0.67	1.13	1.37	0.119	0.92	2.02	1.35	0.131	0.91	1.99
(contextual effect)	0.81	0.004	0.70	0.94	0.85	0.243	0.65	1.12	1.31	0.182	0.88	1.96	1.30	0.195	0.88	1.92
Sex of health workers (Ref: female)																
Male health workers (within-province effect)	0.71	0.190	0.42	1.19	0.71	0.178	0.43	1.17	1.74	0.078	0.94	3.21	1.81	0.065	0.96	3.39
(between-province effect)	1.47	0.023	1.05	2.04	0.96	0.842	0.63	1.47	1.00	0.997	0.61	1.65	0.82	0.508	0.45	1.49
(contextual effect)	1.52	0.013	1.09	2.11	0.99	0.968	0.65	1.51	0.95	0.826	0.57	1.56	0.77	0.382	0.43	1.39
Type of health workers (Ref: doctors)																
Nurse (within-province effect)	0.69	0.019	0.50	0.94	0.63	0.015	0.44	0.91	0.96	0.853	0.64	1.44	0.91	0.654	0.60	1.38
(between-province effect)	1.00	0.953	0.89	1.12	1.13	0.216	0.93	1.37	1.02	0.769	0.89	1.17	0.92	0.464	0.73	1.15
(contextual effect)	1.03	0.572	0.92	1.17	1.18	0.095	0.97	1.44	1.03	0.722	0.89	1.17	0.93	0.506	0.74	1.16
Others (within-province effect)	0.29	<0.001	0.17	0.50	0.29	<0.001	0.17	0.49	1.45	0.367	0.65	3.27	1.46	0.357	0.65	3.25
(between-province effect)	1.02	0.857	0.79	1.32	0.93	0.650	0.69	1.26	1.05	0.785	0.72	1.54	1.00	0.998	0.63	1.58
(contextual effect)	1.16	0.274	0.89	1.50	1.06	0.724	0.77	1.45	1.02	0.933	0.71	1.46	0.96	0.872	0.61	1.51

Multivariate Random Intercepts Logistics Model with Covariates for Pneumonia (Continued from previous page)

	Correct Diagnosis of Pneumonia								Under-diagnosis of Pneumonia							
	With individual-level covariates				With individual- & facility-level covariates (Full Model)				With individual-level covariates				With individual- & facility-level covariates (Full Model)			
	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)
Received IMCI training (Ref: no IMCI)																
Yes, within 12 months (within-province effect)	1.21	0.429	0.75	1.95	1.14	0.586	0.71	1.84	1.09	0.747	0.64	1.86	1.15	0.616	0.67	1.97
(between-province effect)	0.99	0.921	0.88	1.13	0.99	0.933	0.87	1.14	0.96	0.704	0.77	1.20	0.98	0.824	0.84	1.15
(contextual effect)	0.97	0.684	0.86	1.10	0.98	0.759	0.87	1.11	0.95	0.672	0.75	1.21	0.97	0.715	0.82	1.15
Yes, not within 12 months (within-province effect)	1.20	0.313	0.84	1.72	1.17	0.429	0.80	1.71	0.74	0.130	0.51	1.09	0.77	0.181	0.52	1.13
(between-province effect)	1.19	0.048	1.00	1.42	1.24	0.054	1.00	1.55	1.09	0.576	0.81	1.47	1.02	0.863	0.78	1.35
(contextual effect)	1.17	0.095	0.97	1.41	1.22	0.072	0.98	1.52	1.12	0.465	0.82	1.53	1.05	0.727	0.79	1.40
Time spent with pt (min)																
(within-province effect)	1.06	0.043	1.00	1.12	1.06	0.038	1.00	1.12	1.03	0.616	0.93	1.13	1.03	0.609	0.93	1.13
(between-province effect)	0.94	0.318	0.84	1.06	0.99	0.884	0.82	1.19	0.74	0.005	0.60	0.92	0.78	0.060	0.60	1.01
(contextual effect)	0.89	0.080	0.78	1.01	0.93	0.464	0.76	1.13	0.72	0.003	0.58	0.90	0.76	0.041	0.58	0.99
Type of facility (Ref: BHC)																
CHC (within-province effect)					1.25	0.275	0.84	1.88					0.78	0.366	0.46	1.33
(between-province effect)					0.73	0.038	0.55	0.98					1.16	0.450	0.78	1.73
(contextual effect)					0.72	0.024	0.54	0.96					1.19	0.394	0.79	1.79
Subcenter or smaller (within-province effect)					1.07	0.622	0.82	1.40					1.09	0.630	0.77	1.56
(between-province effect)					0.95	0.688	0.74	1.22					1.36	0.066	0.98	1.89
(contextual effect)					0.94	0.649	0.73	1.22					1.35	0.071	0.97	1.87
Presence of clinical guidelines (Ref: No guidelines)																
Clinical guidelines present (within-province effect)					1.13	0.656	0.65	1.97					0.95	0.895	0.47	1.93
(between-province effect)					0.87	0.140	0.72	1.05					0.89	0.359	0.69	1.14
(contextual effect)					0.86	0.142	0.70	1.05					0.89	0.415	0.68	1.17
Evidence of supervision (Ref: No evidence)																
Evidence present (within-province effect)					1.22	0.394	0.78	1.90					0.89	0.725	0.48	1.66
(between-province effect)					1.08	0.507	0.86	1.36					1.22	0.137	0.94	1.60
(contextual effect)					1.06	0.639	0.83	1.35					1.24	0.135	0.94	1.64
Volume of services (Cases)																
(within-province effect)					0.97	0.029	0.95	1.00					1.01	0.543	0.98	1.05
(between-province effect)					1.13	0.005	1.04	1.23					0.98	0.823	0.85	1.14
(contextual effect)					1.16	0.001	1.07	1.27					0.97	0.726	0.84	1.13
Implementation (Ref: MOPH with support)																
MOPH without support (within-province effect)					1.20	0.485	0.72	2.01					1.17	0.561	0.69	1.99
(between-province effect)					0.85	0.022	0.75	0.98					0.94	0.657	0.73	1.22
(contextual effect)					0.84	0.013	0.73	0.96					0.93	0.559	0.73	1.19
NGO only (within-province effect)					0.60	0.064	0.35	1.03					1.31	0.438	0.67	2.56
(between-province effect)					0.94	0.012	0.90	0.99					1.02	0.544	0.95	1.10
(contextual effect)					0.99	0.780	0.92	1.06					0.99	0.920	0.90	1.10

Table 6.12 Results from Multivariate Analysis for correct and under-diagnosis of pneumonia after accounting for clustering at the province level

Table (6.12) displays the results from multivariate logistical models comparing effects of individual and facility level characteristics on correct diagnosis and under-diagnosis of pneumonia.

Correct diagnosis: The results suggested that there was a statistically significant positive association between adherence to clinical guidelines and correct diagnosis of pneumonia. As the main explanatory variable, score on adherence to clinical guidelines, had significant between-province and contextual effects. The between-province effect explained the odds of accurate diagnosis as a function of mean provincial score on adherence to guidelines. Based on the full model, it can be interpreted that if two provinces differed by 10% on their mean provincial score of adherence, the province with the higher score would be expected to have an 83% increase on the odds of correct diagnosis of pneumonia, compared to the lower-scored province (P=0.018). The positive contextual effect showed that if two health workers had the same individual score on adherence but came from provinces which differed by 10% on their mean provincial adherence score, the health worker from higher-scored province would be expected to have a 73% increase in the odds of correct diagnosis of ARI (P=0.034). It was noted that the within-province effect was not statistically significant (P=0.145).

In the full model, the factors that were of statistical significance were type of health workers, duration of consultation, type of health facilities, volume of health services and support from NGOs.

Nurses experienced a within-province effect of 37% reduction in the odds of correct diagnosis of ARI (P=0.015), in comparison with doctors while other types of health workers had a 71% reduction in the odds (P<0.001). No between-province and contextual effects were seen for either nurses or other types of health workers.

Duration of consultation was found to have a within-province effect. Within a given province, if a health worker spent 1 more minute with a patient, she/he could expect to increase their odds of correct diagnosis of ARI by 6% (P=0.038), compared to a health worker from the same province.

Between-province and contextual effects were seen in CHCs when compared to BHCs. The between-province effect suggested that when two provinces differed by 10 percent in their average proportions of CHCs, the province with more CHCs was expected to have a 27% percent reduction on the odds of correct diagnosis (0.038). The contextual effect indicated that when two provinces differ by 10 percent in their mean proportions of CHCs, the BHC from the province with the higher mean proportion of CHCs was expected to have a 28% reduction in the odds of correct diagnosis for ARI, compared to the BHC from the province with the lower mean proportions of CHCs (0.024). These findings were against the presumption that the provinces with higher proportions of CHCs might provide better quality services. These findings are further discussed in the Discussion section.

The effect of total volumes of services was significant at the alpha level of 0.05 for all three of within, between and contextual effects. However, the directions of the effects were not uniform among the three. The within-province effect exhibited a negative association with the odds of correct diagnosis (OR=0.97, P=0.029) while between and contextual effects showed positive associations (OR=1.13, P=0.005, OR=1.16, P=0.001 respectively).

Support from NGOs also seemed to be a significant predictor of correct diagnosis for pneumonia. Between and contextual effects were positive for facilities that operated without any support from NGOs. (These effects can be interpreted in a similar manner as in effects of type of health facilities described in two paragraphs ago.)

Comparing the model with individual-level covariates with the one with both individual and facility-level covariates (full model), it was noted that some of the effects found in the former model disappeared in the latter. Type of caretakers and history of IMCI training in the past were found to be significant factors in the smaller model but they were insignificant in the full model at the alpha level of 0.05. Some of the effects persisted as significant predictors in the full model but the effects were found to either increased or decreased in size. For example, the between-province effect of adherence to clinical guidelines were increased from 1.77 (odds ratio) in the smaller model to 1.83 (odds ratio) in the full model.

Under-diagnosis: Under-diagnosis of pneumonia was found to be negatively associated with adherence to clinical guidelines. The results from the full model predicted that for every 10 percent increase in the adherence score, the odds of incorrectly under-diagnosing pneumonia decreased by 9% (P=0.046) for within a given province. However, between-province and contextual effects were not seen.

There were 4 other covariates that were significantly associated with odds of under-diagnosis. They were age of the patient, sex of the patient, type of caretakers and duration of consultation.

Age of the patient was significant only for the between effect (OR=0.88, P=0.036) and contextual effect (OR=0.89, P=0.049). For sex of the patient, the within-province effect was significant for boys (OR=0.61, P=0.002), meaning that being a boy decreased the chance of under-diagnosis for pneumonia. Caretakers who were not mothers had a within-province effect with the odds ratio 1.52 (P=0.018). Duration of consultation was significant for a contextual effect (OR=0.76, P=0.041).

There was only one covariate the effect of which switched from being significant in the smaller model to non-significant in the full model. It was the between-province effect of the amount of time health workers spent with patients during consultations.

The main predictor variable of interest, adherence to clinical guidelines by the health workers, was found to be associated with both correct diagnosis and under-diagnosis of pneumonia. The predictor showed a significant association with between-province effect and contextual effect for correct diagnosis but for under-diagnosis, these two effects were not found to be significant. A significant association was found only for within-province effect for under-diagnosis of ARI.

The only other explanatory variable that indicated a significant association with both correct and under-diagnosis was duration of consultations. However, it did not show a consistent association across different types of association, i.e. across within-, between- and contextual effects. A within-province effect was seen with correct-diagnosis while a contextual effect was found with under-diagnosis.

Comparing correct and under-diagnosis in the full models (as well as in smaller models), no variable was found to provide a consistent association across different types of association, i.e. across within-, between- and contextual effects.

6.2. Section (6.2) Adherence to clinical guidelines and Accurate diagnosis of Diarrhea

Methodology

Sample

The analysis drew on 1239 observations of children under 5 years of age who presented with diarrheal symptoms to 545 unique facilities across 33 provinces of in Afghanistan in the 2012-2013 round of NHSPA data collection.

Data Source

The analysis of diarrhea drew on the same NHSPA dataset described for the assessment of pneumonia in section 6.1.

Data from the 2012-13 round of NHSPA was used. The outcome variables reflecting accurate diagnosis (correct diagnosis and under-diagnosis) were constructed from Forms 1 & 3. The main explanatory variable of adherence to clinical guidelines as well as other covariates were constructed with the data from Forms 1 & 3 merged with Form 7, matching on health facility IDs.

Case Selection

In the original dataset, there were 3516 total observations across 34 provinces of Afghanistan. Out of those, 1325 cases presented with symptoms of diarrhea to either the health workers or the experts or both. The symptoms included diarrhea or acute bloody diarrhea. 86 observation (6.49% of total) had incomplete data. After careful consideration, these 86 observations were excluded from analysis. The final complete case analysis was performed on 1239 potential diarrheal cases among under 5 children observed in 545 unique facilities across 33 provinces. (Note: Afghanistan is composed of 34 provinces but Nuristan reported no potential diarrhea cases.)

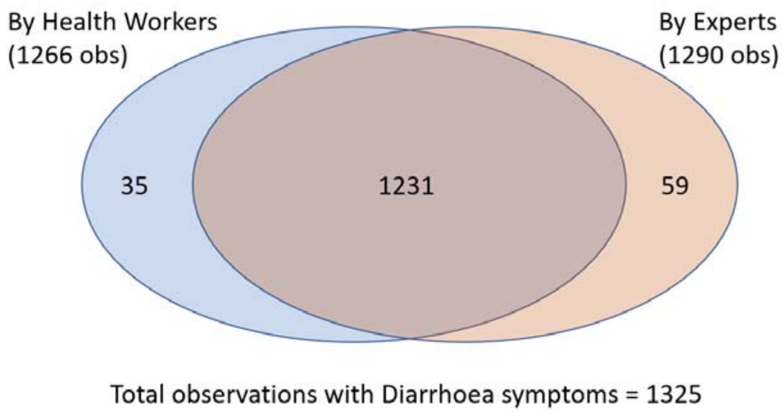


Figure 6.3 Number of cases presenting with diarrheal symptoms to health workers and/or experts

	Original dataset before dropping missing			**Final Working Dataset**		
year	Provinces	Facilities	Observations	Provinces	Facilities	Observations
2012-2013	33	581	1325	33	545	1239

Table 6.13 Sample of children presenting with diarrheal symptoms before and after dropping observations with missing information in any of the variables

Operationalization of Variables

Section (6.2) Outcome of interests: Making accurate diagnoses for Diarrhea

Similar to pneumonia analysis in section 6.1, there were two outcomes of interest for diarrhea analysis here in 6.2. The primary outcome of interest was correct diagnosis whereas the secondary outcome as under-diagnosis of diarrhea.

Both outcomes were constructed in a similar fashion as in section 6.1 for pneumonia. The difference was that there were 6 categories for diarrhea, instead of 3 in pneumonia. The 6 categories defined by IMCI guidelines were

(1) Diarrhea with no dehydration

(2) Diarrhea with some dehydration

(3) Diarrhea with severe dehydration

(4) Persistent diarrhea

(5) Severe persistent diarrhea

(6) Dysentery.

Based on treatment requirements prescribed by IMCI guidelines [135], the 6 categories were recategorized as shown in table (6.14). This recategorization was also consistent with the indicators suggested in a tool developed by WHO to evaluate the quality of care delivered at outpatient facilities [136].

<table>
<tr><th>Original categories in IMCI</th><th>Reorganized categories</th><th>Corresponding Treatment</th></tr>
<tr><td>No dehydration</td><td rowspan="2">No Dehydration</td><td rowspan="2">Oral Rehydration at home</td></tr>
<tr><td>Persistent diarrhea</td></tr>
<tr><td>Some dehydration</td><td rowspan="3">Some/Severe dehydration</td><td rowspan="3">Oral or IV Rehydration at facility</td></tr>
<tr><td>Severe dehydration</td></tr>
<tr><td>Severe persistent diarrhea</td></tr>
<tr><td>Dysentery</td><td>Dysentery</td><td>Antibiotics</td></tr>
</table>

Table 6.14 Recategorization of diagnosis for Diarrhea

Both correct diagnosis and under-diagnosis were binary variables.

<u>Correct Diagnosis of Diarrhea:</u> When the disease categories given by the health workers and the experts coincided, it was regarded as a correct diagnosis.

<u>Under-diagnosis of Diarrhea</u>: If the disease category identified by the health worker was lower than that of the experts, it was defined as under-diagnosis.

Section (6.2) Main Explanatory variable: Adherence to IMCI clinical guidelines by health workers

The adherence to clinical guidelines was constructed in a similar fashion as in SA (2.1). However, the items used to calculate the composite measure were different.

The composite score was composed of 8 mandatory items and 3 skip-pattern-related items, which made the maximum possible score 11. The mandatory items include those which must be assessed regardless of whether the patient presented with diarrhea. These mandatory items served as the foundation in assessing general danger signs of the child patient, which in turn affected the final diagnosis[29]. The 3 skip-pattern-related items were based on whether the health worker asked about diarrhea and whether the patient had diarrhea. The items used were listed in table (6.15).

	Mandatory Items		**Skip-pattern-dependent items**
1	Q110 – Patient age asked		*If diarrhea was present*
2	Q112 – asked about the nature of complaint	**1**	q125a – asked how long
3	Q115 – duration of primary complaint asked	**2**	q125b – asked about blood
4	Q116 – asked if able to drink/breastfeed	**3**	q125c – checked skin pinch
5	Q117 – asked if vomit		
6	Q118 – checked lethargy/consciousness		
7	Q119 - asked about convulsions		
8	Q124- asked about diarrhea		

Table 6.15 Items used to construct the composite score of adherence to guidelines by health workers for diarrhea

The binary items contributed to a percentage score which was constructed by dividing the score by the number of relevant items. As the number of relevant items varied case by case, the denominator also varied. The items for the denominator were counted in such a way that the denominator can accommodate information from missing items. If an observation showed missing information in certain items, the number of such items were subtracted from the denominator so that such observations were retained in the analysis, rather than being dropped. For instance, if an observation showed incomplete information for 2 items, the denominator was calculated as 11-2 = 9 items.

Section (6.2): Covariates

The same set of covariates used in SA (2.1) were used. They were as follows:

Individual Level Factors

- type of health worker
- sex of health worker
- whether the health worker has received IMCI training
- time spent with patients

Supply-side

- age of patient
- sex of patient
- sex of care taker

Demand-side

Facility Level Factors

- Type of health facility
- Volume of health services
- Presence of clinical guidelines
- Evidence of supervision
- Managing organizations/ contracting mechanism

Analysis

Analysis Outline

All the statistical analysis was done in STATA version 14 [112].

The same analysis plan as in ARI in section 6.1 was used here for diarrhea.

Exploratory data analysis was done to assess the extent and pattern of missingness and summary characteristics of the dataset.

Hierarchical bivariate and multivariate logistical regression models were fitted to determine the association between adherence to IMCI guidelines and accurate diagnosis of diarrhea. Random intercepts were included to study separately between-province, within-province and contextual effects. Robust variance estimators were used to the help make the models more 'robust' to mild violation of assumptions.

The between-province, within-province and contextual effects were mathematically estimated using the same models used in section 6.1. They are:

Model (A): LogOdds $(Y_{ij} = 1 \mid X_{ij}, \bar{X}_{i.}) = \alpha_{1i} + \beta_1 X_{ij} + \gamma_1 \bar{X}_{i.}$

Model (B): LogOdds $(Y_{ij} = 1 \mid X_{ij}, \bar{X}_{i.}) = \alpha_{2i} + \beta_2 (X_{ij} - \bar{X}_{i.}) + \gamma_2 \bar{X}_{i.}$

, where Yij = accurate diagnosis indicator

α_1i, α_2i = province-specific intercepts for model 3 and 4

X_{ij} = adherence score of health worker j in province i

$\bar{X}_{i.}$ = mean adherence score in province i

LogOdds $(Y_{ij} = 1 \mid X_{ij}, \bar{X}_{i.}) = \log\left(\frac{\Pr(Yij=1 \mid \alpha ki, Xij)}{\Pr(Yij=0 \mid \alpha ki, Xij)}\right) = \alpha_{ki} + \beta_k X_{ij} + \ldots\ldots.$

$\alpha_{ki} \sim N(\alpha_k, \tau_k^2)$, for each model k.

The models were constructed in such a way that γ_K represents the contextual effect in model A and between-province effect in model B. B_k represents the within-province effect in model B.

Findings

Assessing Missingness

1325 cases of potential diarrhea were assessed for missingness. Table (6.16) displays the extent of missingness.

	Items	variable	Count missing	% missing
1	Patient age asked	q110	0	0.00%
2	asked about the nature of complaint	q112	0	0.00%
3	duration of primary complaint asked	q115	0	0.00%
4	asked if able to drink/breastfeed	q116	1	0.08%
5	asked if vomit	q117	2	0.15%
6	checked lethargy/consciousness	q118	2	0.15%
7	asked about convulsions	q119	2	0.15%
8	asked about diarrhea	q122	0	0.00%
	Ask if diarrhea present			
9	asked how long	q123a	85	6.42%
10	asked about blood	q123b	85	6.42%
11	checked skin pinch	q123c	85	6.42%
12	Age of the patient	ptagemonths	0	0.00%
13	Sex of the patient	q107	0	0.00%
14	Relationship with caretaker	f3q104r	11	0.83%
15	Sex of the health worker	q106	0	0.00%
16	Type of the health worker	q105	0	0.00%
17	Health worker received IMCI training	q106a	1	0.08%
18	Time spent on consultation	q153a	0	0.00%
19	Type of health facilities	q104ft	0	0.00%
20	Presence of clinical guidelines	q900	0	0.00%
21	Had supervision within last 3 months	q1501ab	3	0.23%
22	Volume of health services	volservice	71	5.36%
23	Managing agency	q111m	0	0.00%

Table 6.16 Extent of missingness in the dataset for diarrhea

Although items 1 to 11 showed missingness, they were not excluded from analysis. Instead, attempts were made to glean as much data as possible from these items, in a similar way as in section 6.1. These items were used to construct the variable "adherence to guidelines." Since the variable was a percentage score, it was possible to adjust the denominator according to availability of data. (See the section "Operationalization of Variables" for detail.)

Out of items 12 to 23, 4 items displayed missingness. They accounted for 86 observations (6.49% of total). A complete case analysis was done, excluding these observations (i.e. listwise deletion), which left the final working dataset with 1239 observations.

Exploration of the variables

The final effective sample size of 1239 cases occurred in 33 provinces of Afghanistan. On average, 37.5 observations were seen per province (range; 2 to 77). More than half of the provinces recorded at least 35 observations. The highest number of observations, 77, occurred in Province Kunduz. The province with the least number of observations was Paktika, with only 2 observations. Nuristan was excluded from the analysis since there were no potential diarrhea cases recorded.

The mean number of observations in each facility was 2.27 (range: 1 to 6). The media was 2. Therefore, it was decided that there was not sufficient variability to conduct the originally proposed 3-level analysis. A 2-level analysis, i.e. individual- and province-levels, was chosen.

		No dehydration	Some/Severe dehydration	Dysentery	Row total (row %)
		Expert Diagnosis			
Health Worker Diagnosis	No dehydration	558 (45.0%)	139 (11.2%)	39 (3.2%)	736 (59.4%)
	Some/Severe dehydration	210 (17.0%)	145 (11.7%)	14 (1.1%)	369 (29.8%)
	Dysentery	50 (4.0%)	18 (1.5%)	66 (5.3%)	134 (10.8%)
	Column total (column %)	818 (66.0%)	302 (24.4%)	119 (9.6%)	1239 (100%)
	Correct diagnosis by health workers	**558 (68.2% of no dehydration)**	**145 (48.0% of some/severe dehydration)**	**66 (55.5% of dysentery)**	**769 (62.1% of total)**
	Over-diagnosis by health workers	260 (31.8% of no dehydration)	18 (6.0% of some/severe dehydration)	-	344 (27.8% of total)
	Under-diagnosis by health workers	-	**139 (46.0% of some/severe dehydration)**	**53 (44.5% of dysentery)**	**192 (15.5% of total)**

Table 6.17 Accuracy of diagnoses for diarrhea by health workers

Table (6.17) tabulates the disease categories, correct diagnoses and under-diagnoses by the health workers, highlighted in green and red respectively. The percentages described cell percentages unless otherwise specified. The health workers were able to correctly diagnose 769 cases (62.1% of total). The proportion of correct diagnosis was the lowest in some/severe dehydration group (48%) and the highest in the no dehydration group (68.2%).

There were 192 cases of under-diagnosis which accounted for 15.5% of total potential diarrhea cases. Under-diagnoses for some/severe dehydration was slightly higher (46%) than for dysentery (44.5%).

Summary Characteristics

Characteristics	Individual-level	Facility-level	Province-level
	Average (SD)/ Count (%)	Count (%)	Median (min, Q1, Q3, max)
	n = 1239	n = 545	n = 33
Correct Diagnosis	769 (62.1%)		61% (30%, 50%, 71%, 100%)
Under-diagnosis	192 (15.5%)		13% (0%, 3%, 22%, 50%)
Adherence score to guidelines	0.70 (0.18)		0.69 (0.45, 0.66, 0.74, 0.87)
Age of patient (months)	19.55 (13.57)		19 (14, 16, 23, 32)
Sex of the patient (male)	630 (51%)		50% (22%, 43%, 54%, 69%)
Relationship with caretaker			
Mothers	1006 (81%)		85% (36%, 73%, 89%, 100%)
Non-mothers	233 (19%)		15% (0%, 11%, 27%, 64%)
Sex of the health worker (male)	1164 (94%)		98% (59%, 92%, 100%, 100%)
Type of health worker			
Doctors	585 (47%)		44% (0%, 29%, 59%, 100%)
Nurses	519 (42%)		48% (0%, 36%, 54%, 79%)
Midwife & others	135 (11%)		7% (0%, 3%, 17%, 32%)
Health Worker received IMCI training			
Yes within last 12 months	190 (15%)		7% (0%, 0%, 24%, 78%)
Yes but not within 12 months	534 (43%)		41% (10%, 29%, 50%, 75%)
No IMCI training	515 (42%)		41% (0%, 26%, 66%, 90%)
Time spent on consultation (mins)	6.84 (3.33)		6 (3, 5, 8,12)
Type of Health Facilities			
BHC		660 (53%)	55% (11%, 43%, 61%, 100%)
CHC		358 (29%)	24% (0%, 22%, 35%, 62%)
Subcenter or smaller		221 (18%)	17% (0%, 13%, 22%, 45%)
Clinical guidelines present		1124 (91%)	95% (58%, 86%, 100%, 100%)
Supervision within last 3 months		1144 (92%)	96% (56%, 90%, 100%, 100%)
Volume of health services		10752 (6628)	10572 (5714, 7935, 12478, 19583)
Managing Agency			
MOPH, without support		36 (3%)	0% (0%, 0%, 0%, 78%)
MOPH, with support		652 (53%)	38% (0%, 0%, 96%, 100%)
NGO only		551 (44%)	21% (0%, 0%, 100%, 100%)

Table 6.18 Summary characteristics of variables for analysis for diarrhea

Summary characteristics of the variables used in the analysis were tabulated in table (6.18) at their respective levels.

769 observations had a correct disease category and accounted for 62.1% of total observations. More than half of provinces had a 61% or higher proportion of correct diagnosis. The province with the lowest mean proportion of correct diagnosis, Ghazni with 30 observations, stood at 30% while the province with the highest was at 100% which happened to be Paktika Province with only 2 observations.

Out of 1239 observations, under-diagnosis accounted for 15.5% (192 cases) where health workers gave a diagnosis of a lower disease category than it actually was. It was found that 3 provinces reported no cases of under-diagnosis – Ghazni (30 total observations), Farah (28 total observations), Nimroz (29 total observations), Panjsher (21 total observations) and Paktika (2 total observations).

101 observations (8.15% of total 1239 observations) showed a perfect score of 1. The average adherence score is 0.70 with a standard deviation of 0.18. The median mean score at the provincial level is 0.69 with the interquartile range from 0.66 to 0.74. The province with the mean lowest score is Bamyan (34 total observations) and the highest Kunar (28 total observations).

The average age of children with potential diarrheal symptoms was 19.55 months with a relatively large standard deviation of 13.57 months.

The sexes of the patients were observed to be balanced at the individual level with a male to female ratio of 0.51. However, at the provincial level, the reported mean male to female ratios were as low as 0.22 and as high as 0.69.

The majority of patients, 81%, was brought into the clinic by their mothers.

A similar finding as in ARI cases, the vast majority of potential pneumonia cases was seen by male health workers, i.e. 94%. This empirically reflected the male-dominated profile of healthcare workforce in Afghanistan.

47% of cases were seen by doctors and assistant doctors while 42% were diagnosed by nurses. The remaining 11% were cared for by midwives, community health workers and other types of health workers.

With regards to IMCI training, 15% of the health workforce observed had a training within the last year. The majority, 43%, were given an IMCI training more than a year ago, similar to the finding in pneumonia. 42% (515 health workers) were yet to receive a formal IMCI training.

On average, the health workers spent 6.84 minutes diagnosing and consulting the patient (standard deviation = 3.33 min).

Most observations occurred in Basic Health Centers, at 53%. 29% of cases were observed in Comprehensive Health Centers and 18% in subcenter or smaller facilities.

IMCI guidelines or chartbooks were present in 91% of surveyed facilities. 92% of facilities provided evidence of supervision within the last 3 months.

On average, each facility saw a total of 10752 cases each month. The province with the lowest average monthly cases was Zabul (5714 cases) and the highest Uruzgan (19583 cases).

53% of health facilities were operated by MOPH with the support from NGOs while 44% were by only NGOs. A mere 3% of facilities were managed by MOPH without any support.

Fitting Random Intercepts Logistics Model with No Covariates for Diarrhea (Unadjusted)

	Odds	Std Error	P value	Estimated Proportion (Odds/1+Odds)	Observed Mean proportion	Observed Median proportion
Correct Diagnosis	1.63	0.21	0.000	0.62	0.62	0.61
Under-Diagnosis	0.12	0.03	0.000	0.11	0.16	0.13

Table 6.19 Comparison of estimated proportions of correct diagnosis and under-diagnosis of diarrhea from random intercept logistic models with no covariates with respective observed proportions

Table (6.19) showed estimated proportions of correct and under-diagnoses from a random intercepts model with no covariates. The models gave odds, from which proportions were calculated. The numbers in the table represents the parameters from a typical province, i.e. a province with the random intercept which equaled to 0. The estimated proportions were found to be close to observed proportions.

Sensitivity, Specificity, PPV and NPV of Health Workers' Diagnoses for Diarrhea

	No Dehydration VS Dehydration (A)	**No Dysentery VS Dysentery (B)**
Sensitivity	48%	55%
Specificity	76%	94%
Positive Predictive Value	39%	49%
Negative Predictive Value	82%	95%

Table 6.20 Sensitivity, specificity, positive predictive values and negative predictive values of health workers' in differentiating different disease categories for diarrhea

Table (6.2.7) tabulates the sensitivity, specificity, positive predictive values and negative predictive values of health workers' diagnoses. Column (A) differentiated dehydration cases against no dehydration cases. In treatment terms, it distinguished cases which needed rehydration therapy at the facility against those who could be treated at home. Column (B) differentiated between dysentery and non-dysentery cases – whether they would be prescribed antibiotics or not.

Sensitivity in Column (A) stated that only 48% of cases who needed rehydration therapy were distinguished as such by health workers. Column (B) shows that a mere 55% of cases that called for antibiotics prescriptions were actually categorized as such by health workers. Specificity was relatively high in both columns. It was noted that positive predictive values for both columns were fairly low.

Bivariate Analysis for correct diagnosis of Diarrhea after accounting for clustering at the province level

	Odds Ratio	Std Err	P value	95%	CI
Adherence to guidelines (10% increase)	1.16	0.05	<0.001	1.07	1.26
Age of patient (months)	1.00	0.00	0.753	0.99	1.01
Sex of the patient (ref: female)					
male patient	1.11	0.14	0.395	0.87	1.43
Relationship with caretaker (ref: Mothers)					
Non-mothers	1.08	0.21	0.696	0.74	1.58
Sex of the health worker (ref: female)					
male health worker	0.92	0.34	0.823	0.45	1.90
Type of health worker					
(ref: Doctors)					
Nurses	0.70	0.11	0.021	0.52	0.95
Midwife & others	0.38	0.08	<0.001	0.25	0.56
Health Worker received IMCI training					
(ref: No IMCI training)					
Yes within last 12 months	1.74	0.38	0.011	1.14	2.65
Yes but not within 12 months	1.30	0.18	0.059	0.99	1.70
Time spent on consultation (mins)	1.06	0.03	0.038	1.00	1.11
Type of Health Facilities					
(ref: BHC)					
CHC	1.16	0.18	0.331	0.86	1.58
Subcenter or smaller	1.27	0.24	0.202	0.88	1.85
Clinical guidelines (ref: not present)					
Present	0.88	0.15	0.442	0.62	1.23
Supervision within last 3 months (ref: no evidence)					
evidence of supervision	1.25	0.23	0.243	0.86	1.80
Volume of health services (1000 increase in services)	1.02	0.01	0.142	0.99	1.05
Managing Agency					
(ref: MOPH, with support)					
MOPH, without support	0.78	0.15	0.204	0.53	1.15
NGO only	0.97	0.19	0.859	0.66	1.42

Table 6.21 Results from bivariate Analysis for correct diagnosis of diarrhea after accounting for clustering at the province level

The results from bivariate analysis suggested that there was a statistically significant association between adherence to clinical guidelines and the likelihood of reaching at a correct diagnosis for diarrhea. For every 10 percent increase in the adherence score, the odds of a correct diagnosis increased by 16% ($P<0.001$).

Factors associated with the main outcome of correct diagnosis for Diarrhea at the α level of 0.05 were types of health workers, history of IMCI trainings in the past and duration of consultations with patients.

Compared to doctors, nurses experienced a 30% reduction in the odds of a correct diagnosis ($P=0.021$) while midwives and other health workers faced a further 32% reduction ($P<0.001$). Health workers who had IMCI trainings within the last 12 months had a 74% increase in the odds of correct diagnosis, in comparison with those with no training ($P=0.011$). However, this training effect seemed to disappear if the training was more than a year ago ($P=0.059$). It was also predicted that health workers who spent a minute more with a patient experienced a 6% increase in the odds of correct diagnosis ($P=0.038$).

Bivariate Analysis for under-diagnosis of Diarrhea after accounting for clustering at the province level

	Odds Ratio	Std Err	P value	95%	CI
Adherence to guidelines (10% increase)	0.84	0.05	0.002	0.76	0.94
Age of patient (months)	0.99	0.01	0.387	0.98	1.01
Sex of the patient (ref: female)					
male patient	0.99	0.15	0.935	0.73	1.33
Relationship with caretaker (ref: Mothers)					
Non-mothers	1.03	0.24	0.897	0.66	1.62
Sex of the health worker (ref: female)					
male health worker	0.96	0.31	0.891	0.51	1.79
Type of health worker					
(ref: Doctors)					
Nurses	1.00	0.18	0.983	0.70	1.42
Midwife & others	1.96	0.62	0.033	1.06	3.63
Health Worker received IMCI training					
(ref: No IMCI training)					
Yes within last 12 months	0.74	0.48	0.649	0.21	2.67
Yes but not within 12 months	0.88	0.18	0.526	0.59	1.31
Time spent on consultation (mins)	1.00	0.03	0.872	0.94	1.05
Type of Health Facilities					
(ref: BHC)					
CHC	0.93	0.19	0.738	0.63	1.39
Subcenter or smaller	0.57	0.17	0.064	0.32	1.03
Clinical guidelines (ref: not present)					
Present	1.31	0.30	0.240	0.84	2.04
Supervision within last 3 months (ref: no evidence)					
evidence of supervision	0.92	0.28	0.793	0.51	1.67
Volume of health services (1000 increase in services)	1.02	0.01	0.260	0.99	1.04
Managing Agency					
(ref: MOPH, with support)					
MOPH, without support	1.08	0.18	0.644	0.78	1.51
NGO only	0.96	0.24	0.865	0.58	1.58

Table 6.22 Results from bivariate Analysis for under-diagnosis of diarrhea after accounting for clustering at the province level

In the bivariate analysis after adjusting for clustering at the province level, adherence to guidelines was also found to be associated negatively with under-diagnosis. For every 10 % increase in adherence score, the odds of under-diagnosis reduced by 16% (P=0.002).

The only other covariate that was of significance association was midwives and other types of health workers. Their odds of making an under-diagnosis was 96% higher than that of doctors (p=0.033). Nurses were not found to be significantly more likely to make under-diagnosis, compared to doctors.

Partitioning Between, Within and Contextual Effects

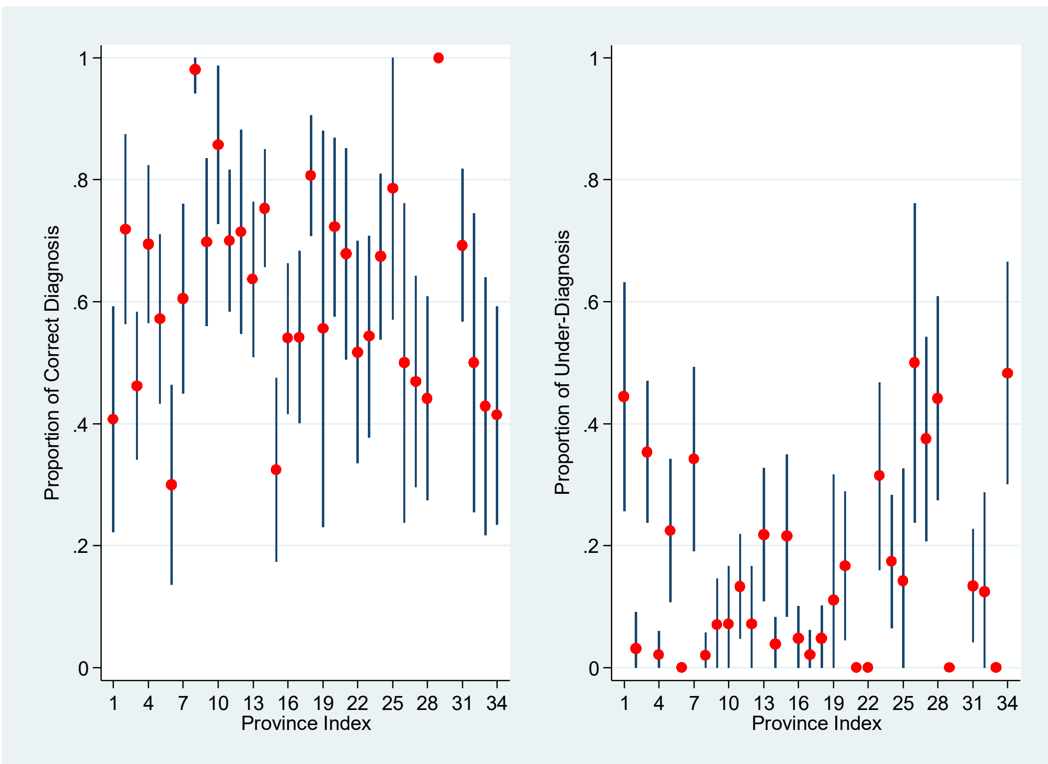


Figure 6.4 Proportions of mean correct diagnosis and under-diagnosis of diarrhea across provinces with 95% CI

The red dots depict the mean proportions of the correct and under- pneumonia diagnoses while the lines represent the 95% confidence intervals for each province. It appeared that there was a certain degree of heterogeneity of in the proportion of correct diagnosis as well as under-diagnosis of diarrhea across the provinces. (Note: Province 19 which had a relatively large confidence interval in corrected was Badghis where only 9 observations were made.)

The following table illustrates the results from bivariate analysis of diarrhea from model A and B without any other covariates.

	Correct Diagnosis of Diarrhea				Under-diagnosis of Diarrhea			
	OR	P value	(95%	CI)	OR	P value	(95%	CI)
Within effect	1.13	0.004	1.04	1.23	0.84	0.002	0.75	0.94
Between effect	1.75	<0.001	1.31	2.33	0.61	<0.001	0.49	0.77
Contextual effect	1.54	0.003	1.16	2.05	0.73	0.013	0.57	0.94

Table 6.23 Within, between, contextual effects of correct and under-diagnosis of diarrhea

The results can be interpreted in a similar fashion as in section 6.1 for pneumonia. Since there were no other explanatory variables other than adherence score, the results were unadjusted values.

For Correct Diagnosis of Diarrhea

Within-province effect can be interpreted as the expected difference in odds ratio of correct dx between two health workers from the same province but who differ in adherence score by 10 percent. Within a given province, the odds of correct diagnosis of a health worker increased by 13% with every 10 percent increase in adherence score (P=0.004).

Between-province effect can be interpreted as the expected difference in mean odds ratio of correct dx between two provinces which differ by 10 percentage points in their mean adherence score. If the two provinces differ by 10 percent in their mean adherence score, their mean odds of correct diagnosis will differ by 75% (P<0.001)

Wald chi square test was conducted to see if between effect was stitistically different from within effect. The test was positive with a chi square statistic of 28.81 (P<0.001).

Contextual effect can be interpreted as the expected difference in odd ratios between two health workers with the same adherence score but who come from two provinces that differ in average provincial adherence score by 10 percent. The finding suggests that for two health workers who had the same adherence score, their odds of reaching at a correct diagnosis would differ by 54% if the province they were in differed in mean adherence score by 10 percent (P =0.003).

For Under-Diagnosis of Diarrhea

Contextual, within- and between- province effects for under-diagnosis can be interpreted similarly as in correct diagnosis.

Within-province effect If the adherence scores of two health workers from the same province differed by 10 percent, the health worker with the higher adherence score would be expected to have a 16% reduction in the odds of incorrectly under-diagnosing diarrhea. The effect was statistically significant at $\alpha=0.05$ (P=0.002).

Between-province effect If the two provinces differed by 10% in their mean provincial adherence score, the health worker from the higher scored province could expect to have a 39% reduction in the odds of under-diagnosis of diarrhea

A Wald chi square test was positive between the within- and between-province effects, with a chi square statistic of 14.18 and a p-value of 0.0008.

Contextual effect A reduction in 34% in the odds of under-diagnosis would be seen in a health worker compared to another health worker who had the same individual-level adherence score but came from a province that had 10% lower mean provincial score of adherence (P=0.047).

Multivariate Random Intercepts Logistics Model with Covariates for Diarrhea

	Correct Diagnosis of Diarrhoea								Under-diagnosis of Diarrhoea							
	With individual-level covariates				With individual- & facility-level covariates (Full Model)				With individual-level covariates				With individual- & facility-level covariates (Full Model)			
	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)	Odds Ratio	P-value	(95%	CI)
Adherence Score-10 percent increase																
(within-province effect)	1.06	0.256	0.96	1.17	1.07	0.188	0.97	1.19	0.85	0.011	0.74	0.96	0.84	0.013	0.74	0.96
(between-province effect)	1.91	0.005	1.22	3.00	1.18	0.314	0.85	1.64	0.24	<0.001	0.17	0.33	0.58	0.338	0.19	1.76
(contextual effect)	1.80	0.012	1.14	2.85	1.11	0.560	0.79	1.55	0.28	0.003	0.12	0.65	1.08	0.712	0.70	1.67
Patient age (months)																
(within-province effect)	1.00	0.649	0.99	1.01	1.00	0.599	0.99	1.01	0.99	0.478	0.98	1.01	1.00	0.489	0.98	1.01
(between-province effect)	0.97	0.078	0.94	1.00	1.02	0.378	0.97	1.08	0.84	<0.001	0.79	0.91	0.86	0.003	0.78	0.95
(contextual effect)	0.97	0.075	0.93	1.00	1.02	0.414	0.97	1.08	0.89	0.001	0.83	0.95	0.86	<0.001	0.81	0.92
Sex of patient (Ref: female)																
Male patient (within-province effect)	1.07	0.553	0.85	1.36	1.09	0.490	0.85	1.39	0.99	0.933	0.74	1.32	0.97	0.824	0.71	1.31
(between-province effect)	1.13	0.193	0.94	1.36	1.11	0.332	0.90	1.37	0.74	<0.001	0.69	0.80	0.57	<0.001	0.47	0.69
(contextual effect)	1.12	0.227	0.93	1.35	1.10	0.363	0.90	1.35	0.74	<0.001	0.68	0.81	0.66	<0.001	0.59	0.75
Type of caretakers (Ref: mothers)																
Non-mothers (within-province effect)	1.14	0.527	0.76	1.69	1.13	0.547	0.76	1.69	1.06	0.815	0.66	1.69	1.06	0.798	0.67	1.70
(between-province effect)	1.18	0.264	0.88	1.57	0.97	0.797	0.80	1.18	1.03	0.674	0.89	1.20	0.90	0.764	0.44	1.82
(contextual effect)	1.16	0.311	0.87	1.56	0.96	0.716	0.78	1.18	0.93	0.551	0.72	1.19	1.23	0.111	0.95	1.58
Sex of health workers (Ref: female)																
Male health workers (within-province effect)	0.52	0.041	0.28	0.97	0.52	0.041	0.28	0.97	1.66	0.155	0.83	3.31	1.63	0.168	0.81	3.26
(between-province effect)	1.07	0.665	0.78	1.47	0.79	0.108	0.59	1.05	1.26	0.001	1.10	1.44	1.15	0.672	0.60	2.20
(contextual effect)	1.14	0.388	0.84	1.56	0.84	0.252	0.63	1.13	1.12	0.396	0.86	1.46	1.09	0.638	0.77	1.54
Type of health workers (Ref: doctors)																
Nurse (within-province effect)	0.81	0.221	0.59	1.13	0.78	0.158	0.56	1.10	0.92	0.698	0.61	1.40	1.04	0.873	0.66	1.62
(between-province effect)	0.96	0.537	0.86	1.08	0.91	0.134	0.81	1.03	0.80	<0.001	0.73	0.88	0.89	0.254	0.72	1.09
(contextual effect)	0.98	0.796	0.87	1.11	0.93	0.279	0.83	1.06	0.79	0.072	0.60	1.02	0.94	0.204	0.86	1.03
Others (within-province effect)	0.39	<0.001	0.28	0.55	0.40	<0.001	0.28	0.56	1.93	0.039	1.03	3.61	1.96	0.034	1.05	3.65
(between-province effect)	0.93	0.634	0.70	1.24	0.89	0.230	0.73	1.08	0.67	<0.001	0.59	0.76	1.00	0.993	0.58	1.73
(contextual effect)	1.02	0.871	0.77	1.37	0.97	0.779	0.80	1.18	0.89	0.587	0.59	1.35	0.80	0.228	0.56	1.15

Multivariate Random Intercepts Logistics Model with Covariates (Continued from previous page)

	Correct Diagnosis of Diarrhoea								Under-diagnosis of Diarrhoea							
	With individual-level covariates				With individual- & facility-level covariates (Full Model)				With individual-level covariates				With individual- & facility-level covariates (Full Model)			
	Odds Ratio	p-value	(95%	CI)	Odds Ratio	p-value	(95%	CI)	Odds Ratio	p-value	(95%	CI)	Odds Ratio	p-value	(95%	CI)
Received IMCI training (Ref: no IMCI)																
Yes, within 12 months (within-province effect)	1.37	0.161	0.88	2.13	1.40	0.131	0.90	2.16	0.70	0.360	0.33	1.49	0.66	0.310	0.29	1.47
(between-province effect)	0.91	0.032	0.84	0.99	0.93	0.058	0.85	1.00	1.34	<0.001	1.25	1.42	1.17	0.016	1.03	1.33
(contextual effect)	0.88	0.023	0.79	0.98	0.90	0.021	0.81	0.98	1.38	<0.001	1.19	1.61	1.21	0.001	1.08	1.35
Yes, not within 12 months (within-province effect)	1.06	0.624	0.83	1.36	1.06	0.613	0.84	1.35	0.97	0.893	0.65	1.45	0.93	0.750	0.61	1.43
(between-province effect)	0.97	0.804	0.77	1.22	1.16	0.059	0.99	1.35	1.50	<0.001	1.34	1.68	0.77	0.427	0.41	1.46
(contextual effect)	0.97	0.764	0.77	1.21	1.15	0.087	0.98	1.36	1.36	0.002	1.12	1.66	0.82	0.108	0.64	1.05
Time spent with pt (min)																
(within-province effect)	1.00	0.936	0.95	1.06	1.00	0.897	0.95	1.06	1.06	0.071	1.00	1.13	1.06	0.077	0.99	1.12
(between-province effect)	1.02	0.720	0.92	1.12	1.02	0.621	0.94	1.11	0.70	<0.001	0.65	0.77	0.92	0.144	0.82	1.03
(contextual effect)	1.02	0.806	0.90	1.15	1.02	0.754	0.91	1.14	0.71	<0.001	0.61	0.82	0.75	<0.001	0.68	0.83
Type of facility (Ref: BHC)																
CHC (within-province effect)					0.89	0.498	0.63	1.25					0.96	0.888	0.58	1.61
(between-province effect)					0.84	0.080	0.70	1.02					1.73	<0.001	1.33	2.26
(contextual effect)					0.85	0.109	0.70	1.04					1.61	<0.001	1.33	1.95
Subcenter or smaller (within-province effect)					1.45	0.053	1.00	2.12					0.58	0.076	0.32	1.06
(between-province effect)					1.10	0.448	0.86	1.40					0.62	0.109	0.34	1.11
(contextual effect)					1.06	0.670	0.82	1.37					0.54	0.006	0.35	0.84
Presence of clinical guidelines (Ref: No guidelines)																
Clinical guidelines present (within-province effect)					0.86	0.379	0.62	1.20					1.22	0.458	0.73	2.03
(between-province effect)					1.08	0.314	0.93	1.26					1.00	0.991	0.77	1.30
(contextual effect)					1.10	0.245	0.94	1.29					0.89	0.207	0.75	1.06
Evidence of supervision (Ref: No evidence)																
Evidence present (within-province effect)					1.12	0.503	0.81	1.54					0.88	0.753	0.41	1.91
(between-province effect)					1.29	<0.001	1.12	1.48					0.96	0.868	0.58	1.58
(contextual effect)					1.27	0.002	1.09	1.49					0.91	0.262	0.76	1.08
Volume of services (Cases)																
(within-province effect)					1.02	0.157	0.99	1.05					1.00	0.928	0.97	1.03
(between-province effect)					1.10	0.162	0.96	1.25					0.86	0.001	0.78	0.94
(contextual effect)					1.07	0.295	0.94	1.23					0.92	0.013	0.86	0.98
Implementation (Ref: MOPH with support)																
MOPH without support (within-province effect)					1.01	0.947	0.68	1.51					1.13	0.735	0.56	2.28
(between-province effect)					0.82	0.006	0.71	0.94					0.97	0.847	0.69	1.35
(contextual effect)					0.82	0.008	0.71	0.95					1.01	0.916	0.78	1.33
NGO only (within-province effect)					0.91	0.830	0.39	2.12					0.94	0.938	0.22	4.02
(between-province effect)					0.98	0.373	0.94	1.02					0.97	0.387	0.90	1.04
(contextual effect)					0.99	0.844	0.90	1.09					1.02	0.849	0.86	1.20

Table 6.24 Results from Multivariate Analysis for correct and under-diagnosis of diarrhea after accounting for clustering at the province level

The results from multivariate logistic models are tabulated in table (6.23).

<u>Correct diagnosis:</u> The main explanatory of interest, adherence to IMCI guidelines, showed positive associations in only the smaller model, i.e. with between-province and contextual effects. It did not provide any significant association with correct diagnosis of diarrhea in the full model.

The variables that substantiated significant effects in the full model were sex of health workers, history of IMCI training in the past, evidence of supervision and support from NGOs.

Male health workers showed a significant association with correct diagnosis of diarrhea. The within-effect from the full model suggested that within a given province, males providers were predicted to have a 48 percent decline in the odds of correct diagnosis, in comparison with their female coworkers (P=0.041).

Contextual effect for IMCI training suggested that even if two health workers had the same adherence score, the health worker from the province with 10% higher average proportion of staff with IMCI training in the past year was expected to see a 10% reduction in the odds of correct diagnosis of diarrhea than the other health worker. This was a counter-intuitive finding at a first glance, which was discussed further in the following Discussion section.

Evidence of supervision showed positively associated between-province effect (OR=1.29, P<0.001) and contextual effect (OR=1.27, P=0.002) for correct diagnosis.

Support from NGOs also demonstrated negative associations with between province effect (OR=0.82, P=0.006) and context effect (OR=0.82, P=0.008) on correct diagnosis, suggesting that support from NGO would likely increase the chance of correct diagnosis.

There was only one variable the effect of which switched from being significant in the smaller model to non-significant in the full model, i.e. after controlling for confounding for facility-level characteristics. It was the between and contextual effect of the main predictor variable, adherence to clinical guidelines.

Under-diagnosis: Adherence to clinical guidelines indicated a significant negative association with within-province effect on the odds of under-diagnosis. The more the health workers follow guidelines, the less likely they were to reach at a false-negative diagnosis. Within-province effect can be interpreted as that every 10% increase in the adherence score for a health worker, she/he could expect to see a 16% decrease in the odds of under-diagnosis, comparing with another health worker in the same province. Between-province and contextual effects were significant in the smaller model with only individual-level covariates but these effects dissolved after controlling for facility-level factors included in the full model.

The other covariates that were significant in the full model for under-diagnosis of diarrhea were age of patients, sex of the patient, type of health workers, training on IMCI, time spent by health workers for consultation, type of health facilities and total monthly volume of services provided at each facility.

Patients' age was significantly associated with between-province effect (OR=0.86, P=0.003) and contextual effect (OR=0.86, P<0.001) for under-diagnosis. Both effects pointed that the higher the age of the patient, she/he was less likely to be under-diagnosed.

Being a male patient was associated with the lower chance of being under-diagnosed for diarrhea, as evident in between-province effect (OR= 0.57, P=<0.001) and contextual effect (OR=0.66, P<0.001).

When compared with doctors, other types of health workers (apart from nurses) showed increased odds of under-diagnosis. The between effect recorded in the full model provided evidence that there was a 96% increase in the odds of under-diagnosis with other types of health workers, compared to doctors (P=0.034). Nurses did not prove to be significantly different from doctors in this regard.

The findings which go against common presumptions were found with IMCI training, time spent with patients, type of health facilities and volume of services. It was unexpected to see that health workers who were trained for IMCI in the past year were more likely to under-diagnose diarrheal cases when compared with health worked who did not receive any IMCI training, as found in between-province effect (OR=1.17, P=0.016) and contextual effect (OR=1.21, P=0.001). Also, the negative association of duration of consultation with likelihood of under-diagnosis was found in contextual effect in the full model (OR=0.75, P<0.001). According to between-province effect and contextual effect in CHCs, i.e. type of facility, provinces with higher proportions of CHCs are more likely to be associated with higher odds of under-diagnosis. Similarly, provinces with higher volumes of services were predicted to be associated with increased odds of under-diagnosis of diarrhea. It was also noted that these "unorthodox" direction of the effects was found only with between and contextual effects, not with within-province effects. Thought experiments on these findings were described further in the Discussion section.

There was only one variable the effect of which dissolved after adjusting for potential confounders at the facility-level. It was between-province effect of type of health workers on the under-diagnosis of diarrhea.

Comparing the results from the full models for correct-diagnosis and under-diagnosis, only one variables demonstrated significant association with both outcomes of interest. It was the contextual effect of having received IMCI training within 12 months compared to no IMCI training (although the direction of the effect was contrary to what was expected).

Three covariates showed significant association with correct diagnosis but not with under-diagnosis in respective full models. They were sex of health workers, evidence of supervision and support from NGOs.

On the other hand, 4 covariates showed significant association with under-diagnosis but not with correct diagnosis. These covariates were type of health workers, duration of consultation, type of facility and total volume of services provided at each facility.

Looking at correct diagnosis and under-diagnosis in both smaller models and full models, there was only covariate which showed consistent significant association across all the models. It was the contextual effect of having received IMCI training within 12 months compared to no IMCI training.

The main predictor variable, adherence to clinical guidelines, showed significant association with under-diagnosis but not with correct diagnosis in respective full models.

Discussion

This chapter explored the likelihood of accurate diagnosis and under-diagnosis of pneumonia and diarrhea in children under five years old, as a function of process quality of health care, as objectively measured by adherence to IMCI clinical guidelines by health workers, after adjusting for individual and facility-level characteristics.

Although many studies have assessed the determinants of different measures of quality of care for children in different contexts, a literature search did not identify any studies that separated the effects of adherence (as well as the effects of other demand- and supply-side characteristics) on accurate diagnosis of diarrhea and pneumonia into between-, within-province and contextual effects. Based on this apparent limit of knowledge, the current study can be regarded as the first study to fill that knowledge gap.

The current study assessed 4 outcomes as a function of adherence to clinical guidelines, together with other individual and facility-level covariates. The 4 outcomes were (1) correct diagnosis of pneumonia, (2) under-diagnosis of pneumonia, (3) correct diagnosis of diarrhea and (4) under-diagnosis of diarrhea. The study examined the relationship between the 4 outcomes and the predictors through 3 different effects (also termed associations). The 3 effects/associations were: (1) within-province effects, (2) between-province effects and (3) contextual effects of provincial characteristics.

The results suggested that, holding other variables constant, following prescribed guidelines played an important role in reaching a correct diagnosis and/or avoiding under-diagnosing both at the individual level and provincial level.

There was a significant association between adherence and correct diagnosis as well as under-diagnosis for pneumonia and diarrhea although the effects of adherence on diagnosis were observed with different patterns for the two diseases.

For pneumonia, correct diagnosis was significantly affected by the between-province and contextual effects of adherence, while under-diagnosis was significantly affected by the within-province effect of adherence. The positive between-province effect demonstrated that provinces with higher mean adherence scores were more likely to have an increased odds of a correct diagnosis. The contextual effect indicated that even if the two health workers had the same adherence score, the province they were in had an effect on the outcome of accurate diagnosis. The health worker from the province with the higher mean adherence score was more likely to correctly diagnose pneumonia.

For diarrhea, no significant association was found between correct diagnosis and within-, or between-province or contextual effects. However, a within-province effect of adherence to guidelines was found to be significantly associated with under-diagnosis, providing evidence of the effect of adherence on individual-to-individual variability of the odds of under-diagnosis within a given province.

Age of the patient was found to be significantly related to under-diagnosis of both pneumonia and diarrhea through between-province and contextual effects. Provinces with higher mean age were less likely to under-diagnose both diseases compared with provinces with lower mean age. Furthermore, a higher provincial mean of patient age had a negative effect on the individual odds of under-diagnosis. In other words, both effects favored older children, reducing the chance of under-diagnosis of both diseases.

In previous studies, age was a known predictor of quality of care for children despite its contradicting directions of association. The finding of the present study was in line with a research in the South African Republic which reported that among children presenting with fever, those who were older than 12 months were more likely to be correctly treated than were younger children [92]. However, a study in 2009 from Afghanistan reported a negative relationship between age and quality of care [94]. The research found that process quality, as measured by adherence to clinical standards, was higher when health workers were examining children younger than 2 years. Another study published in 2012 found the opposite effect of age, claiming that children under 12 months of age received better quality of care compared to children between 12 to 59 months in Afghanistan. However, it should be noted that these previous studies examined clinical process quality as their outcome, in contrast to the current study in which the outcome of interest was whether an accurate diagnosis was made or not; the two outcomes in the two studies were different measures of quality. In fact, the main predictor variable of the current study was process quality, which was assessed as the outcome in previous studies.

Based on these two studies, age was also included in the model to control for confounding. The mechanism through which age affected the outcome on diagnosis was not clear. A possible mechanism for the finding in the present study might be that it was more difficult to perform physical examination, and assess clinical signs, in younger children than in older children.

While the sex of the patient had a significant effect on under-diagnosis of ARI and diarrhea, no such effect was seen on correct diagnosis. The child's sex demonstrated a significant within-province effect in under-diagnosis of pneumonia, and between-province and contextual effects in under-diagnosis of diarrhea. All of these effects favored boys.

One explanation might be cultural challenges. Male health workers might be reluctant to conduct a thorough clinical examination which might require removal of clothes and close physical contact, particularly given the relatively gender-conscious nature of Afghanistan. It is noteworthy that the health workforce of Afghanistan is predominantly male, and more than 90% of the observations in this study were by male health workers.

Another possible reason for the effect of patient's sex might be the perceived lesser 'value' of girls in certain societies. It was well known that boys were preferred in countries such as China and India [137, 138] and little girls might not be viewed and treated equally. Yet, the counter-argument to such a theory might be that the preference for a certain sex of a child might go in either direction. A research involving 50 developing countries reported that preference for sons was not always found and preference for girls was prevalent in many societies [139]. Furthermore, the effect of patient's sex on quality of care could be modified by provider's sex, which is discussed in the following paragraph. In a broader picture, the effects of sex on health-related outcomes are complex and ubiquitous in many other outcomes too, such as sex-specific abortions, imbalanced sex ratios and sex differentials in infant/child mortality, just to name a few, indicating that the effects of sex on health outcomes are yet to be better understood.

Assessment of the effect of the provider's sex on the outcome showed that a between-province effect was found for correct diagnosis of diarrhea. This effect suggested that female health workers had a higher likelihood of correctly categorizing cases of diarrhea. The finding was in line with a study from Malawi which found that females were more likely than males to treat malaria in children correctly. That said, the same study reported that it was again females who were more likely to over-treat malaria too [140]. In the context of Afghanistan, previous studies reported that female health workers tended to provide better observed quality health care not only to children but also to adults [75, 94].

Another study in Afghanistan reported the interaction between sex of the provider and sex of the patient. When both were females, higher quality of care was observed. Although the study hypothesized that this situation was due to easier interaction between two females, (as opposed to more difficult communication between opposite sexes), the effect was also influenced by other characteristics, such as duration of consultation and age of the patient. The same study reported no effect modification between sex of the provider and sex of the patient if the patient was older than 10 years [75].

Type of caretaker exhibited a within-province effect in under-diagnosis of pneumonia only – i.e. not in 3 other diagnoses. If a child was brought into the clinic by a person who was not her/his mother, the child was more likely to receive an under-diagnosis, (and hence was likely to forego important treatment such as antibiotics or urgent referral to a higher facility), than was a child brought by their parent. A similar finding was reported in an earlier study in Afghanistan [94], which reported that children received better quality of clinical assessment as well as counselling care when brought in by females/mothers. The reason might be that mothers know the history of the child better than anyone else, as they were often the primary caretaker of the children in the family. However, confirming this suggestion was outside the scope of the current study.

Type of health workers was also a known predictor of quality of care in Integrated Management of Childhood Illnesses although the direction of the effect was often contradictory between studies in different contexts. A study from Morocco reported that nurses provided better process quality of care than did doctors [141]. The finding was replicated in two studies in Brazil [85, 142]. In contrast, studies in Indonesia and India reported that doctors provided better care than did nurses [143, 144]. In the context of Afghanistan, previous studies reported that doctors provided higher quality of care. Edward et al. found that doctors' performance was better than that of other health workers [95]. Similarly, Hansen reported that, when broken down by patient age group, health care quality differential was higher for doctors in the patients older than five years, but there were no differences between health worker types for patients less than 5 years old [75]. The same study proposed that the difference might be due to two phenomena: (1) examination of older children and adults might be more complex than that of younger children, and (2) the items used to measure service quality for children might be different than those for adults. It was common that children under five years of age were examined according to clinical guidelines prescribed in IMCI. However, in adults, similar standard clinical criteria were not used as widely.

The current study found that doctors provided better quality of care as measured by accurate diagnosis in some conditions but not all. The analysis reported evidence of a within-province effect that doctors outperformed nurses and other type of health workers in the correct diagnosis of pneumonia. However, there was no significant difference between doctors, nurses and other cadres of health workers in under-diagnosis of pneumonia, or correct diagnosis of diarrhea. However, other types of health workers showed increased likelihood of under-diagnosis of diarrhea, performing worse than doctors and nurses.

Consultation length was found to be significantly associated with contextual effects on under-diagnosis of both pneumonia and diarrhea and, in correct-diagnosis of pneumonia. All the three significant associations were in favor of spending more time with patients. These findings corresponded to findings from earlier studies in Afghanistan which demonstrated that providers who spent more than 10 mins per consultation were more likely to provide better quality of care than those who spent less than 10 mins [94, 95]. However, the current study reported no effect of duration of consultation on correct diagnosis of diarrhea.

Volume of services were found to have significant between-province and contextual effects on under-diagnosis of diarrhea. The negative association found among them showed that facilities with higher volumes reduced the likelihood of under-diagnosis of diarrhea in the form of between-province and contextual effects. A potential reason is that as health workers saw more cases of diarrhea, their diagnosis became more accurate, i.e. their performance was raised with practice, repeating the old adage *practice makes perfect*. Another explanation is that health workers who worked in areas where incidence of diarrhea was higher were more concerned about dehydration. Such health workers might have been assessing the severity of dehydration in diarrhea cases with a more generous sensitivity.

'Unexpected' results were found in the associations between the outcome of interest and 2 covariates. These 2 covariates were whether the workers had received IMCI training (and when), and type of health facilities.

The study reported that IMCI trainings had no effect on the correct and under-diagnoses of pneumonia, yet demonstrated unexpected associations with correct and under-diagnoses of diarrhea. The contextual effect was significant in correct diagnosis of diarrhea. The between-province and contextual effects were significant in under-diagnosis of diarrhea. These effects implied that provinces with higher mean proportions of providers who had been trained within the previous year were more likely to incorrectly categorize severity of cases of diarrhea. In other words, trainings showed certain adverse effects on the said diagnoses of diarrhea.

The IMCI trainings have been a topic of discussion by policy makers and implementers. Several studies provided evidence that training of health workers, with a specific focus on IMCI case management, could bring about improvement in the quality of care for children at frontline health facilities [85, 86, 89, 92]. However, other studies showed dissociation between coverage of IMCI training and quality improvement of care. A study in Uganda found that IMCI training did not always lead to improved health worker clinical performance [90], findings which were echoed in the current study.

This finding was in accordance with the long standing caution by authorities that an immense challenge in training of health workers is to maintain proven effectiveness of training during the expansion of the intervention to a sufficient coverage level that was necessary to result in a meaningful population-level impact [145]. The current study mirrored that warning. During the bivariate analyses of individual level factors on individual level outcome, 3 of the outcomes were found to be associated with trainings. The 3 outcomes were correct diagnosis of pneumonia, correct diagnosis of diarrhea and under-diagnosis of diarrhea. The bivariate analyses indicated that better adherence would likely increase the chance of correct diagnosis of pneumonia and diarrhea and reduce the chance of under-diagnosis of diarrhea, highlighting the importance of IMCI training. Yet, when population level factors were taken into consideration in the analyses, the desired effect of IMCI trainings became diluted, and even reversed with certain outcomes, as reported in the previous paragraph.

There were at least six possible explanations for this finding. (1) Although the models included information on whether the health workers had received IMCI trainings and the timing of such training, no adjustments were made for the quality of the trainings, for example the intensity and duration of the trainings, who conducted the trainings, and number of trainings each health worker received. (2) Health workers might respond differently to the same training, possibly resulting in different skill and knowledge levels. Therefore, when the health workers were grouped only by the timing of their training, the group likely contained providers with varying levels of skill. (3) The sustained effects of training over time on health workers were most likely to be different among health workers who had been trained. (4) There might be spill-over effects between the health workers who had been trained and those who had not, especially if they worked in the same health facility. The direction of the spill-over effect could go either way. (5) The spill-over effect could also extend from the individual level, i.e. between health workers in the same facility, to the provincial level, i.e. between facilities within the same province. (6) A possible confounder was the motivation of the health workers. This aspect was not directly controlled for in the models of the current study.

Types of health facilities also displayed associations with the outcomes of interest, and some of these associations contradicted common assumption that higher-level facilities would provide better care. The effects of types of health facility were seen in the correct diagnosis of pneumonia and under-diagnosis of diarrhea, as between-province and contextual effects in both diseases. These effects implied that higher-level Comprehensive Health Centers were performing worse than Basic Health Centers for these particular diagnoses. While these effects could be considered as surprising, they did reflect findings from earlier studies which reported that types of health facilities were not consistent predictors of quality of care and that higher-level facilities did not always provide better care. A 2009 study in Afghanistan reported that clinical assessment was better in Comprehensive Health Centers than in Basic Health Centers in 2005, but not in 2006. The same study also found, in 2005, no difference in clinical assessment quality between Basic Health Centers and District Hospitals, despite the latter being two levels higher than BHCs. However, there was a difference in 2006, when better assessment quality was found in district hospitals than in BHCs. In 2004 and 2005, CHCs reported better counselling care than the District Hospitals which were defined as higher-level in the referral chain [94]. Explanation of these findings would require further analysis, which would in turn need to draw on more information.

In the present study, one noteworthy 'surprising' association, which violated common presumptions, was that the unexpected associations were found only in between-province and contextual effects, not in within-province effects. Perhaps these findings indicated that residual confounding was present, especially at the provincial level. Certain provincial level characteristics might be partly related to the individual-level features. The degree to which province-level characteristics are related to individual-level properties might vary between different province-level variables. Also, the pathways linking group-level constructs to individual outcomes were likely to be complex, and involve reciprocal causation and feedback loops. All of these are known to make the assessment of group-level effects on individual outcomes challenging, especially in observational datasets [146-149].

One other possible explanation was confounding by non-random assignment of health workers with certain characteristics within a particular facility, or within a province, or non-random access by patients to a particular health facility. For example, patients with certain characteristics (sicker or poorer, or with a mother who spoke a specific dialect) may have a preference to access a particular health facility over another. Or there were certain characteristics that made people reside within a province. Or there may be certain characteristics of health workers who were attracted to, or dissuaded from, working in a particular facility or province. These features could make the contextual effect more pronounced.

Ancillary analyses of the study reported the validity of health workers diagnoses in terms of sensitivity, specificity, positive predictive values, and negative predictive values. Among the 4 tools, it was noted that sensitivity was relatively very low in differentiating between severe pneumonia and non-severe pneumonia cases (26%). In terms of clinical management, the difference between severe and non-severe pneumonia cases was that the former merits urgent referral processes. The sensitivity of 26% indicated that only 26% of ARI cases that needed referral to a higher facility received referral and the other 74% did not. Sensitivity was also found to be low in differentiating between dehydrated and non-dehydrated diarrhea cases (48%), meaning that 52% of children that needed rehydration therapy might not have received it. These findings should help elicit action from implementers.

On a positive note, specificity was high in differentiating between severe and non-severe cases of ARI (99%). This high specificity, in conjunction with low sensitivity, can be interpreted as health workers performed better in deciding if the patients did not need referral, than if the patients did need referral. Given that referral may alter the potential health outcome of the child, ultimately affecting her/his life, it was better to err on the safe side. Therefore, efforts should be made to increase the sensitivity of recognizing severe cases of pneumonia and diarrhea in children in Afghanistan.

The study has a number of limitations.

The outcome variables of interest, correct and under-diagnosis, were recategorized according to treatment guidelines. For example, diarrhea with no dehydration, and non-severe persistent diarrhea, were merged together into the same group because neither need oral or IV rehydration therapy in the facility, nor urgent referral. Had they been categorized differently, this could have an effect on the results of correct diagnosis.

The main predictor variable, adherence to clinical guidelines by health workers, was constructed from observations of clinical examination of health workers by surveyors. Therefore, the data might be influenced by observation bias, i.e. the health workers might behave differently when under observation. The bias could have affected the observation either positively or negatively, depending on how each health worker responded. If health workers tried to follow the guidelines more strictly in the presence of an observer, this would have over-estimated the adherence, similar to the concept of the original Hawthorne effect. Conversely, if health workers feel stressed when under observation, this might negatively affect their performance.

Construction of several variables could be improved. For example, the variable 'evidence of supervision' was constructed from whether there was evidence of supervision from a higher level within the past three months. The variable did not take into account the type of supervision, who conducted the supervision, or the quality of supervision, all of which could show variability. Therefore, although the variable was included in the analysis with the purpose of controlling supervision-related confounding, residual confounding might still be present. The same can be said of IMCI training. The variable used in the analyses elucidated if the health workers received training and when. It did not contain any other qualitative information on trainings.

Through the use of multi-level models, the study attempts to link provincial-level constructs to individual-level variables. However, it had been warned that the pathways linking group-level constructs to individual outcomes were likely to be complex, and involve reciprocal causation and feedback loops [146]. Dealing with this goes beyond the analytical methods used in this study and other (quantitative as well as qualitative) complementary approaches will be needed.

This is a cross-sectional observational study and therefore care must be taken when making causal inferences.

Despite its limitations, the study provided evidence of association between adherence to clinical guidelines and accurate diagnoses for pneumonia and diarrhea, after adjusting for certain individual and facility-level characteristics. The results of the study underline the need to ensure process quality in the delivery of care in frontline facilities of Afghanistan. Furthermore, this is the first study to separate the between-province, within-province and contextual effects, of adherence to IMCI guidelines, as well as certain demand and supply side characteristics on the accurate diagnosis of two of the top diseases responsible for the persistent high mortality of children under 5 in Afghanistan. The result can facilitate evidence-based decision making for implementers and policy makers.

7. Chapter (7): Conclusions

Summary of Findings

The dissertation revolved around health care quality improvement efforts in Afghanistan through collaboration between the Afghan Ministry of Public Health and international partners since the fall of the Taliban in 2001. Decades of conflicts and instability had left the country with a devastated health system and poor health indicators. Through implementation of a Basic Package of Health Services (BPHS) starting in 2004 and an Essential Package of Hospital Services (EPHS) starting in 2005, the primary health care system of the country as well as its core referral structure were redefined.

The idea was to improve both 'quantity' of services and 'quality' of services. Given the country's towering maternal and child mortality rates, maternal and child health have been key foci in the planning and implementation strategies since the conception of BPHS and EPHS. The dissertation used data from the Afghan National Health Service Performance Assessments (NHSPA), which were conducted almost annually between 2004 and 2013, to monitor the progress and effects of BPHS and EPHS.

The dissertation approached and utilized NHSPA data based on the foundation provided by the conceptual framework described in Chapter (3). The chosen framework was a result of modification and integration of two frameworks – (1) a conceptual model for evaluating the scale-up of maternal and child survival put forward by Bryce et al. and (2) Donabedian's Structure-Process-Outcome approach to quality of care. Under the roadmap of the framework, Study Aim (1) assessed the effect of structural quality of maternity-specific care while Study Aim (2) explored the effect of process quality of pediatric care.

To be specific, SA (1) examined the quantitative association between improvements in the structural quality of maternal services and the increase in facility births using longitudinal data analysis methods exploiting the longitudinal nature of the NHSPA datasets collected between 2004 and 2013. Although there are many previous studies about determinants of quality of care and determinants of institutional delivery, few studies have explored the association between structural quality of maternal services provided at frontline health facilities and institutional delivery rates, especially in the context of Afghanistan. The results for SA (1) were described in Chapter (5). The findings provided strong evidence that structural quality improvement of maternal health services was positively associated with facility deliveries. For every 10% increase in a maternal structural quality score, there was a 9% increase in the rate of institutional deliveries after controlling for other facility-level characteristics ($P<0.001$). The NGO supported facilities were found to have 27% higher institutional delivery rates than facilities without such support ($P<0.001$). Increase in the rates of institutional deliveries was also associated with facility types, number of staff and total volume of services provided at the facilities.

In Chapter (6), SA (2) examined the association between process quality of pediatric care, as measured by health workers' adherence to IMCI clinical guidelines, and their likelihood to provide accurate diagnosis for pneumonia and diarrhea for children under 5 years of age. Using hierarchical modelling methods on National Health Services Performance Assessment Data from Afghanistan collected in the 2012-13 round of assessment, which uniquely involved validation of health workers' diagnoses by re-examination of the same patients by experts, the two conditions of pneumonia and diarrhea were assessed separately. Multi-level analysis methods made it possible to separate the effects of process quality of health care, on health workers' likelihood of giving accurate diagnosis, into within-province, between-province and contextual effects. Both demand-side and supply-side characteristics were adjusted in the analyses. The results provided strong evidence of association between adherence to IMCI guidelines by health workers and their likelihood to reach an accurate diagnosis for pneumonia and diarrhea in children under five years of age although the effects were observed in different patterns for the two diseases. For correct diagnosis of pneumonia, between-province and contextual effects of adherence to guidelines were found to be significant ($OR=1.77$, $P=0.001$, $OR=1.67$, $P=0.003$ respectively). For correct diagnosis of diarrhea, none of the within-province, between-province and contextual effects of following guidelines were significant. However, significant within-province effects of adherence were seen in under-diagnosis of both pneumonia (OR=0.91, P=0.046) and diarrhea (OR=0.84, P=0.013). In simpler terms, the results illustrated that health workers who closely followed the IMCI guidelines were more likely to give correct diagnosis and avoid under-diagnosis than health workers who did not closely follow the guidelines.

Study Limitation and Strengths

One limitation of the study, in addition to those specific and described in previous chapters, was that the data used in the analyses were not current, and might not reflect the present situation in Afghanistan.

Another caveat was that the study was dependent upon the data collected only in health facilities observing the interactions between health workers and the users who were actually able to access public facilities. These users of health care might be systematically different from those who could not, or would not, access such services. Also, it is not certain that the observations, analyses and findings will be representative of types of services other than public services although most public services were currently provided with support from NGOs.

Another limitation of the study lies with the choice of models. Both Study Aims used regressional mathematical models which implicitly assume that outcomes are dependent on explanatory variables, and do not take into account reciprocity of causation. In the real world, there may be feedback loops through which outcomes can in turn affect inputs.

Be that as it may, the choice of the models can also be seen as one of the strengths of the study. Due to constraints including data availability and prohibitive cost involved, it is not common that public health analyses can be made on health facility data which is collected longitudinally at a scale as large as the datasets used in the study. By exploiting the longitudinal nature of the dataset, and taking advantage of clustering of observations within facilities which are nested with provinces, the study employed longitudinal data analysis methods in SA 1 and multi-level modelling methods in SA 2. These methods can help give less biased estimation results, and can separate the variability of measures into within-group and between-group variabilities. Although the usage of these methods is commonly found in organizational psychology, sociology, biomedical sciences, econometrics and other fields, they are still gaining momentum in health systems research. The study can add to the growing evidence on health system strengthening efforts, including facility-level quality improvement strategies from a unique perspective.

Policy Recommendations & Implications

The results from investigation of both Study Aims indicated that the efforts of quality improvement of Afghanistan's health services were associated with envisioned effects. The findings in SA (1) demonstrated that improving structural quality of maternal services at frontline facilities of the country were associated with increased coverage of skilled birth attendance in the form of increased facility births at public facilities. The analyses in SA (2) showed that process quality played a significant role in accurately diagnosing pneumonia and diarrhea in children under five years of age, whether to correctly identify the severity of the condition and/or to avoid missed treatment.

Facility delivery has been heralded as one of the core strategies in bringing down maternal deaths while accurate diagnosis and correctly assessing the severity of the diseases lie at the heart of the clinical management of childhood illnesses. Therefore, the main implication of this study is adding to the knowledge base for those who are trying to bring down maternal and child mortality in a country struggling with instability and conflict.

The findings offer strong empirical evidence to the health authorities of Afghanistan, donors and implementing partners, that improving the structural and process quality delivered at primary health care facilities, as well as those in the referral chain such as district hospitals were significantly associated with desired results envisioned in BPHS and EPHS implementation, particularly in the area of rapid scaling up of maternal and child health services. The findings of the current study should help stimulate multiple concerned stakeholders to continue investment, and renew focus on ensuring that not only are services available to people of Afghanistan, especially the disadvantaged and the marginalized, but also that the services provided are of high quality.

With its granularity in findings on quantitative association between quality improvement efforts and desired outcomes, the present study can contribute to the agenda setting and dialogue on identifying effective, efficient and acceptable means to optimize health care quality, with a specific focus on mothers and children, as part of a broader mission of strengthening health systems of the country as a whole within a reasonable timeframe.

Another implication lies with the emphasis on understanding context, and how context can affect (facilitate or limit) the success of well-intentioned programs and services. Analyses on both SA (1) and SA (2) modelled outcomes of interest as a function of individual-, facility- and provincial characteristics. This approach allowed us to see not only how the deliberate actions were affecting the envisioned outcomes but also how the envisioned outcomes were affected by other factors, either inside or outside of the main program efforts.

For example, SA (2) explicitly takes into account the contextual effect of the health facilities and provinces on individual outcomes, demonstrating how individuals were functioning differently within provinces and between provinces. By systematically separating the within-province and between-province effects on individual-level outcomes, SA (2) quantified the contextual effect of provinces which was found to be statistically significant. In other words, when attempts were made to partition the within- and between-province effects, this was tackling the question of to what extent were the observed variations between provinces explained by the characteristics of the patients and the health workers residing/working in them.

In the language of multi-level modelling statistics, this situation is usually framed as context versus composition. The findings of the study signaled that the variations between provinces were not completely explained by composition effects alone and that there were some contextual effects. Some of these contextual effects were found to favor our quality improvement efforts while some contextual effects hindered the intended results, undermining the effectiveness of our endeavors. This finding was a reminder to policy makers and implementers that they were not operating in a vacuum and that there were many other factors at play which had affected (and will likely to continue to affect) their intended results.

To optimize intended results, stakeholders should be aware that well-intended standardization of packages of services may bring quick results in the short and medium terms (as found in other studies). However, strategies should also be appropriate for the long term, with a particular respect to flexibility. Central planners and policy makers should draw on the experience and insight of mid-level managers, and people working at ground zero, to understand the pathways of the results they achieved (or the lack thereof), and why and how contextual factors, (especially those they were not formerly aware of), were affecting the results of the programs or services. When necessary, further research should be conducted or commissioned to understand the situation better. To put it another way, the findings of the present research illustrated that health systems strengthening efforts, ranging from planning, implementation and adaptation to commissioning research and seeking feedback, must be contextualized at appropriate levels, i.e. individual, facility, village, provincial or national level. For that to happen, there should be an ongoing dialogue and adaptability among multiple stakeholders at and between different levels, and the venues for such communication and flexibility should be explicitly described and deliberately operationalized in implementation strategies.

8. Annex

Annex (1) Detailed Information on the Structure and Functions of the Health Care System

Structure of the Health Care System
The BPHS is offered in four standard types of health facilities below the level of the provincial, regional, and national hospitals (MoPH, 2005). The four standard types of health facilities are the health post (HP), basic health center (BHC), comprehensive health center (CHC), and District Hospital (DH). These services include outreach by community health workers (CHWs) at HPs, outpatient care at BHCs, and inpatient services at CHCs and DHs. In addition, services are provided through health sub-centers (HSC) to bridge the gap between HPs and other BPHS levels of service delivery and mobile health teams (MHT).

Health Post (HP): At the community level, basic health care services are delivered by CHWs from their own homes, which function as community HPs. An HP, ideally staffed by one male and one female CHW, covers a catchment area of 1,000 to 1,500 people, which is equivalent to 100-150 families. CHWs offer limited curative care, including diagnosis and treatment of malaria, diarrhea, and acute respiratory infections such as pneumonia; distribution of condoms, oral contraceptives, and depot medroxy progesterone acetate (DMPA) injections; community DOTS; growth promotion and nutrition counseling; and micronutrient supplementation. CHWs are responsible for treating minor illnesses and conditions common in children and adults, for awareness-raising on disability and mental health, and for identification of persons with disabilities and mental conditions. The routine management of normal deliveries is not part of the CHW's job description, but female CHWs focus on promoting birth preparedness, safe home deliveries with a skilled birth attendant (when possible), awareness of the danger signs of pregnancy, the need for urgent referral when delivery complications occur, and basic essential newborn care.

Health Sub-Centers (HSC): The Health Sub-Center (HSC) is an intermediate health deliver facility to bridge the services gap between HPs and other BPHS levels of service delivery. The overall objective of establishing HSCs is to increase access to health services for underserved populations residing in remote areas. A HSC is intended to cover a population of about 3,000-7,000. The maximum walking distance to a HSC is two hours for the consumer of health services living in remote areas. The HSC provides most of the BPHS services that are available in BHCs including health education, immunization, antenatal care, family planning, TB case detection and referral, and follow up of TB cases in coordination with community DOTS. In addition, HSCs will be able to treat infectious diseases such as diarrhea and pneumonia. HSCs will refer severe and complicated cases to higher level facilities. The HSC is staffed by two technical staff (a male nurse and a community midwife), as well as a cleaner/guard.

Mobile Health Team (MHT): Another way to ensure access to basic health services in remote areas is the provision of health care services through mobile health teams. Mobile health services are an extension of BHC services; therefore, the services they provide are in most cases those recommended for a BHC. The MHT ideally has the following staff, male health provider (doctor or nurse), female health provider (community midwife or nurse), vaccinator and driver.

Basic Health Center (BHC): The BHC is a small facility that offers the same services as an HP but with more complex outpatient care. The BHC supervises the activities of the HPs in its catchment area. The services of the BHC cover a population of 15,000-30,000 people, depending on the local geographic conditions and the population density. In circumstances where the population is very isolated, the catchment population for a BHC can be less than 15,000. The minimal staffing requirements for a BHC are a nurse, a CHW, and two vaccinators. Depending on the scope of services provided and the workload of the BHC, up to two additional health care workers (HCWs) may need to be added to perform well-defined tasks (e.g., supervision of community health workers and outreach activities).

Comprehensive Health Center (CHC): The CHC covers a larger catchment area of 30,000-100,000 people, offering a wider range of services than the BHC. In addition to assisting normal deliveries, the CHC can handle certain complications, grave cases of childhood illness, treatment of complicated cases of malaria, and outpatient care for mental health patients. The facility has limited space for inpatient care but does have a laboratory. Staff of a CHC outnumber staff of a BHC and include both male and female doctors, male and female nurses, midwives, and laboratory and pharmacy technicians. Additionally, the CHC aims to provide maternal health care services, particularly comprehensive emergency obstetric care services.

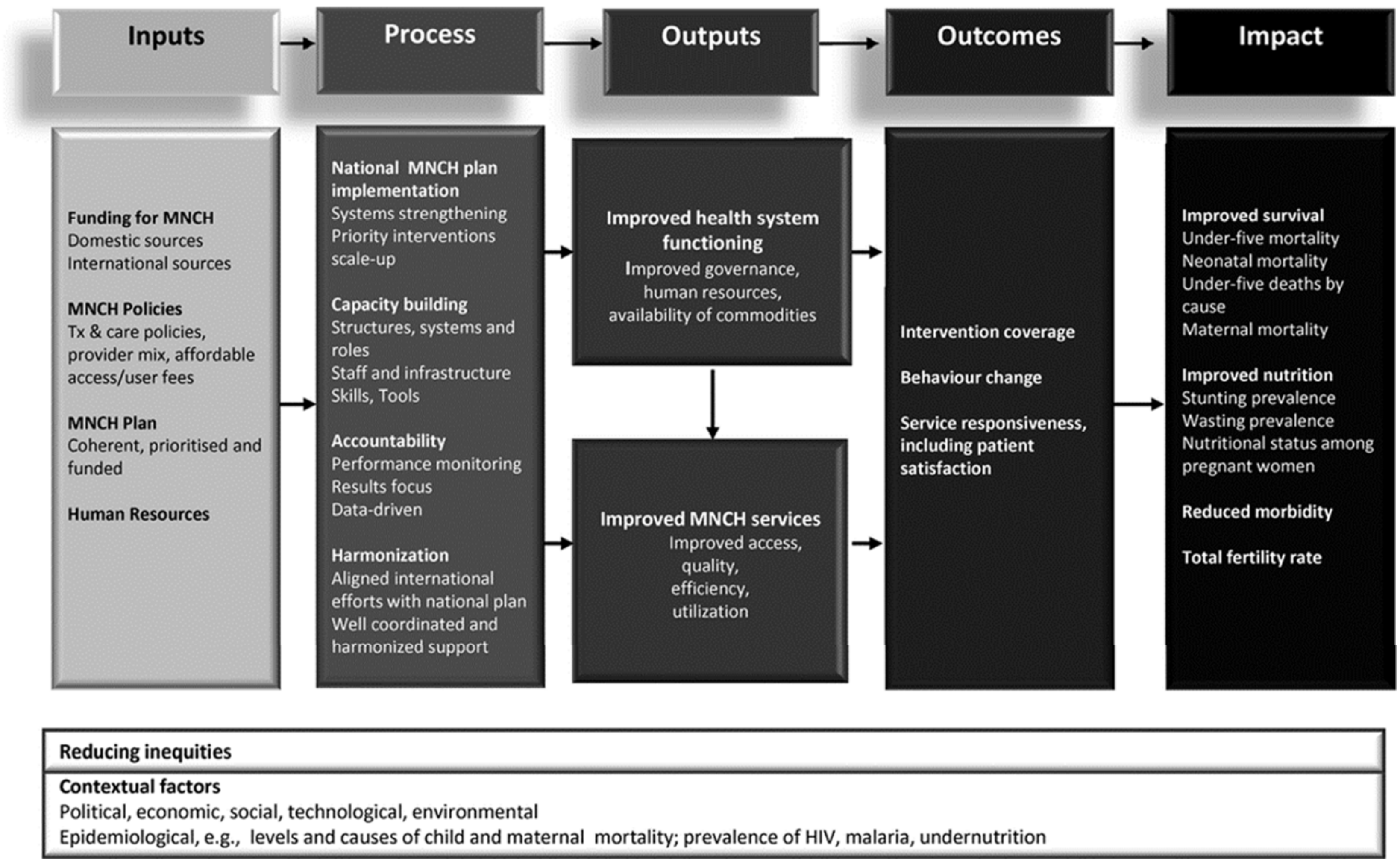
District Hospital (DH): The DH handles all services in the BPHS, including the most complicated cases. The hospital is staffed with female obstetricians/gynecologists, a surgeon, an anesthetist, a pediatrician, midwives, laboratory and X-ray technicians, a pharmacist, a dentist, and a dental technician. Each DH covers an approximate population of 100,000 to 300,000 people dispersed in one to four districts.

Provincial Hospital (PH): The PH is the referral hospital for the Provincial Public Health (PPH) Care System. In essence, the PH differs little from a DH: it offers the same clinical services and possibly a few additional specialty services. In most cases, the PH is the final referral point for patients referred from the districts. In some instances, the PH can refer patients to higher levels of care in the regional hospital or to a specialty hospital (SH) in Kabul.

Regional Hospital (RgH): The RgH is primarily a referral hospital with a number of specialties for assessing, diagnosing, stabilizing and treating, or referring back to a lower-level hospital. The RgH provides professional inpatient and emergency services at a higher level than is available at DHs and PHs, yet the overall objective remains reduction of maternal mortality, infant mortality, and under-5 mortality as well as reduction in other diseases and conditions responsible for high mortality and morbidity.

National Hospitals (NH): NHs or SHs are referral centers for tertiary medical care and are located primarily in Kabul. They provide education and training for HCWs and act as referral hospitals for the PHs and RgHs. As of 2011, there are 10,277 health posts, 468 health sub-centers, 807 basic health centers, 388 comprehensive health centers, 67 district hospitals, 29 provincial hospitals, 5 regional hospitals and 24 national hospitals throughout the country (MoPH, 2011).

Annex (2) A Common Framework for Evaluating the scale-up for maternal and child survival (Original Framework by Bryce et al.[97])



Annex (3) Extraction of institutional deliveries from datasets from different years

Year	Item	Variable
2004	no of (x) months	q625x
	Total no of deliveries in (x) months	q625
2005	No of deliveries assisted in facility in Month 1	q822a
	No of deliveries assisted in facility in Month 2	q822b
	No of deliveries assisted in facility in Month 3	q822c
	No of deliveries assisted in facility in Month 4	q822d
	No of deliveries assisted in facility in Month 5	q822e
	No of deliveries assisted in facility in Month 6	q822f
2006	Similar to 2005	
2007	Similar to 2005	
2008	Similar to 2005	
2009	Similar to 2005	
2011	No of institutional deliveries within last 6 months	q408ba
2012	Similar to 2011	

Table 8.1 Extraction of institutional deliveries from datasets from different years

Annex (4) Thesis Research Documentation Form

The Johns Hopkins Bloomberg School of Public Health

Thesis Research Documentation Form

Please complete the following and provide to Angelica Watts, W1033 Wolfe Street.

Htet Nay Lin Oo	International Health	DrPH
Student's name	Department	Degree program

Research Topic: _ Saving Mothers and Children in a Post-Conflict Country: Improving the Quality of Maternal and Child Health Services in Afghanistan

THESIS ADVISORY COMMITTEE

Provide the names of the thesis advisory committee members. The role of the thesis committee is to provide continuity in the evaluation of the progress and development of the student. **Please note, there are no school-wide requirements for the number of members (internal or external to the department) however, please consult with your department regarding departmental requirements**. Committee membership is permitted to change during the research phase. *This committee should not be confused with the Final Oral Examination Committee.*

1) ____David Peters______________________________ Advisor

2) ____Joanne Katz______________________________ Thesis Committee Member

3) ____Elizabeth Colantuoni_______________________ Thesis Committee Member

4) _________________________________ Thesis Committee Member

5) _________________________________ Thesis Committee Member

RESEARCH COMPLIANCE

☐ The proposed dissertation project involves human participants or individually identifiable data generated from or about humans.
(see Student Manual posted on www.jhsph.edu/IRB for information). Check one of the below:

☐ A new protocol was submitted to the IRB and approved on ________

Faculty PI _______________ Protocol number _______________________

☐ The student was added to an existing protocol and approved on________

☐ The student was added to an external protocol: Institution_______________
PI_____________
Protocol Number ___________Approved on____________ (Provide Documentation)

Faculty PI _______________ Protocol number _______________________

☐ The project was designated as either Not Research or Not Human Subjects Research by the
JHSPH IRB office on__________________ (provide documentation)

☐ IRB approval will be sought once the project is further established (remember to update this form)

☐ The proposed dissertation project involves animals

Animal Care and Use Committee (ACUC) Approval received on __________

Faculty PI _______________ Protocol number ________________________

☐ ACUC approval will be sought once the project is further established.

X The proposed dissertation project will not involve animals, human subjects, or individually identifiable data from or about humans.

☐ **Responsible Conduct of Research Required Coursework**

X 550.600 (*Responsible Conduct of Research*) Year - 2012-13

☐ 306.665 *(Research Ethics and Integrity)* Year – Not taken__

X Other …(550.860 - Academic and Research Ethics) Year – 2013-14

_____Htet Nay Lin Oo _____________________ __6.7.2016__

Student Signature (date)

7/14/2016

Advisor signature (date)

9/23/2016

Academic Coordinator signature: (date)

Annex (5) Citation

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Annex (6) Curriculum Vitae

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Education

· **DrPH** Candidate (Health Systems)	Johns Hopkins Bloomberg School of Public Health	2018
· **MSc Public Health** (Health Services Management)	London School of Hygiene and Tropical Medicine	2010
· **Post Grad Diploma in Social Work**	University of Yangon	2009
· **M.B.,B.S**	University of Medicine 2, Yangon	2006

Work

2012 – 2018 JOHNS HOPKINS BLOOMBERG SCHOOL OF PUBLIC HEALTH

- Part time Research Assistant to various research and implementation projects
- Part time Teaching Assistant to various courses including Biostats, Application of Systems Thinking in Public Health, Managing Health Organizations in LMICs and Introduction to International Health

2014 – 2015 FUTURE HEALTH SYSTEMS

- Graduate Consultant to Monitoring and Evaluation of Maternal and Neonatal Implementation for Equitable Systems Project (MANIFEST) in Uganda

2012 WORLD HEALTH ORGANIZATION

- Central Project Coordinator to Myanmar Artemisinin Resistance Containment Project, WHO (Myanmar)

2011 - 2012 A LINN KYI PROGRAM

- Founder/Coordinator
- With own financial contribution and contribution from family and relatives, founded "A Linn Kyi" Program focusing on education and empowerment of poor and vulnerable women. "A Linn Kyi", with financial assistance from Alumni Grant Program of Open Society Institute which was individually awarded to me, has implemented a project in Dala Township, one of the worst peri-urban poverty pockets, empowering women by providing sewing skills and improving market access.

2010 – 2011 MYANMAR BUSINESS COALITION ON AIDS

- Consultant (M&E and Research)

2008 – 2009 UNFPA/ MYANMAR MEDICAL ASSOCIATION

- Training Consultant

2007 – 2008 MYANMAR BUSINESS COALITION ON AIDS

- Project Officer/Assistant Project Officer

2006 – 2007 **MYANMAR BUSINESS COALITION ON AIDS**

- Team Leader (Education Program)

2005 – 2006 **THINGANGYUN GENERAL HOSPITAL, SOUTH OKKALAPA WOMEN AND CHILDREN HOSPITAL**

- Medial Resident

Extracurricular Achievements & Activities

- Initiated and founded "Phat Pee Pyan Htar" mini-libraries all over Myanmar after raising more than 4,000 dollars through a social media campaign within 48 hours. (Click here for more information.) Within 2 months, it totaled up to more than 10,000 dollars. More than 90% of the funding came from small donations from local Myanmar people.
- After my paternal grandmother passed away in 2013, our family inherited her house and 2.4-acre land. We decided to donate the house as well as the land to the city. Contributing a seeding fund of 25,000 US dollars out of our pockets, our family transformed it to become ***the first private daycare center for the aged in Myanmar***. It is free, not-for-profit and caring for 15-20 elderly daily. (Click here to see a video promo I produced for the center.)
- Selected as a ***Peace Ambassador*** to attend a peace conference in Japan. Voted as the secretary for South East Asian countries. Successfully helped advocate multinational companies including Sony to contribute to the good cause (2000).
- Selected as a ***Junior Ambassador***, at the age of 12, to attend a peace conference in Japan. (1993).